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THE APPROACH TO COMPREHENSIVE PLANNING FOR WATER QUALITY CONTROL

by

Keith S. Krause*

Comprehensive river basin management of water resources is certainly a timely topic for discussion. Administrators, planners and technicians in the water field are thinking about it, talking, planning, and yes, even arguing about its possibilities as an effective answer to our many water problems. The idea of comprehensive management of our water resources is not a new one. In a limited sense it has been practiced in many areas of the world, including the United States, for many years.

The logic of a comprehensive plan approach to resource control is seldom attacked. However, the ways and means of implementing such a program are subjected to a good deal of discussion, exploration and demonstration.

My remarks here today will be limited to a discussion of the approach being taken to carry out the mandate of Congress as expressed in Section 2 of the Federal Water Pollution Control Act, as amended. Section 2 requires that the Secretary of Health, Education, and Welfare prepare or develop comprehensive water pollution control programs in cooperation with other Federal, State, interstate, and local water pollution control agencies for eliminating or reducing water pollution in surface and underground sources for all purposes. It also requires that, in the planning of any Federal reservoir, consideration must be given to storage for flow regulation for water quality control. The Secretary of Health, Education, and Welfare must advise on the need for and the value of such storage to the appropriate Federal agency.

We believe that the provision in the Federal Water Pollution Control Act requiring the development of a program for water pollution control is a logical one. The fact that it appears in the second section of the Act is not happenstance. As administrators we know the value of program planning. The Water Pollution Control Act provides for an orderly process of planning and implementation including financial, technical and legal authorities for accomplishing the task. The Act also places a great deal of emphasis on the prevention of water pollution, as well as control. Prevention, it seems to me, is impossible without some forethought or the development of some type of plan which will accommodate those things which we anticipate may pose a threat to the health and welfare.

I must agree with those who believe the "last word" on water pollution control program planning and development is yet to be spoken.

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Nevertheless, I would like to describe to you today the approach being taken by the Federal agency which I represent, toward the development of the plan phase for comprehensive water pollution control.

Over the past several years, as our programs have geared to the comprehensive plan approach to water quality management, we have come to some rather definite conclusions. First, it seems to us that comprehensive water quality management can best be--and perhaps only be achieved--if it is viewed as a river basin or watershed goal. It does not seem feasible that a comprehensive plan can evolve from any group of disconnected, individual or subregional plans. It also seems to us that water quality and quantity are inseparable factors, both controllable, under ideal management, to an extent which will allow continued multiplicity of uses.

We believe that quality control can be exerted most efficiently and effectively by removing as much of the pollutant as is practical as near the source as possible, and this is the point of major emphasis to which any pollution control program should be geared. We are aware that it may be neither practical nor feasible to change engineering practices which have developed great sewer systems in cities, towns and metropolitan areas. However, this does not prevent us from advocating and emphasizing source control.

We view flow regulation as a practical measure which can be applied as a second line of defense against the inroads of pollution from a treated residual waste where those wastes are not susceptible to further practical treatment or removal and better quality of water is called for.

Thus, by controlling pollution at the source and/or by stream regulation, each supplementing the other, we have a "double-barreled" system for managing water quality. Each system offers protection not afforded by the other, and each must be constantly adjusted and balanced according to the kind of water quality desired at specified points in the river basin.

The achievement of a water quality management program will permit most uses of water to be sustained. It is part and parcel of the total water resource development program and is compatible with the National policy to develop the Nation's waterways for all legitimate uses. It will be necessary, however, to balance these uses so as to eliminate or lessen conflicts. This can only be done through coordinated planning, construction and operating processes.

In organizing for the preparation of our comprehensive water quality management programs, we have concluded that the project-type organization is superior to others both in terms of accountability in work accomplishment and fiscal matters. Therefore, as we initiate our basin studies, we are establishing special groups whose sole function is to undertake the necessary planning endeavors in each of the 21 major river basins or related regions in the United States.

We are systematically scheduling these projects so that all can be started and most of them finished within the next six years. We now have virtually completed one and have six others underway. These are the Arkansas-Red River Project, the Columbia River Basin Project, the Great Lakes-Illinois River Basins Project, the Delaware River Estuary Project, the Ohio River Project, the Chesapeake Bay-Susquehanna River Basins Project, and the Southeastern Rivers Project. The Colorado River Basins Project is primarily an enforcement action.

A comprehensive water quality management plan is the result of a number of fundamental steps. Our approach consists of two major elements. One includes the investigations leading to summary information concerning the physical, chemical and biological characteristics of the streams, lakes, and subsurface aquifers which have an effective role in the natural watershed. It is a compilation of the peculiarities--personalities, as it were--of the waterways of a basin; for example, a waterway's volume in terms of frequency distribution, its response to pollution stimuli, its flow velocity, its natural chemistry, its biology and microbiology. It includes the amount of water withdrawn, and the characteristics and amounts of used water returned. It includes all portions of the basin system receiving pollutants or likely to receive pollutants. This information can be expressed by a series of numerical values, ranges, statistical frequencies, probabilities and locations. These values are representative of observations made in a variety of frequencies and locations, gathered over a long enough period of time to make them statistically valid and broad enough in coverage to assure that no major environmental influence is omitted. This is, of course, one of the fundamental aspects of the planning phase and is necessary to the formulation and calibration of our planning tools.

The second major element of our approach is the summarization of the resource, economic and physical characteristics which can be recognized as having an influence on the future development of the area served by the waterway. Such a summary includes the economic resources, financial and other growth characteristics and opportunities, represented by a series of values, rates, frequencies, probabilities and locations. It must include many assumptions, such as the expected and planned rates of expansion by area utilities such as gas, electric, water and telephone; by the financial interests, the banks, the Federal Reserve system, business and industry, forecasting interests, industrial management and urban planning. In short, one element represents present conditions, the other the potential future conditions. Together they form the basis for preparing the plan.

At this point in the development of a comprehensive plan we must determine the water quality goals to be achieved. These must be placed in numerical values and qualified as to time, place and purpose. Realizing that such goals are not uniform and may vary widely from river to river, we are attempting to rationalize them by seeking regulatory and user groups' opinions through the formation of advisory groups on the kind of water which should be supplied at given places, and even at given times if possible, in the stream system. We are now engaged in furthering the work so well assembled and compiled by Cal Tech and sponsored by the California Water Pollution Control Board. We hope that these efforts will enable these groups to have the very best information available to them when quality values are selected. We believe that you, as pollution control administrators, should have a role in the furtherance of the water quality objectives. I understand a committee has been formed to study this and met yesterday. Once the water quality goals have been established, it is the planner's responsibility to set up and simulate a system which would provide the quality desired, using source control of pollution and such additional control as may be available by streamflow regulation. The planner and his advisers must then decide which of several alternatives would give the greatest efficiency and economy and is administratively feasible.

Thus, you will recognize that this problem in decision making is amenable to systems analysis techniques. These techniques will be employed extensively in our projects. We intend to carry the planning far enough to illustrate the quality of the water which can be discharged, where sewer outfalls should be located to minimize pollutional effects on downstream water uses, and what streamflow regulation will be required and relative costs.

The planning report will contain: (1) estimates of quantity, location and time that water uses will be incurred; (2) estimates of quantity, quality, location and time of discharge of waste waters which will be returned to the streams; (3) a summary of waste removal and treatment required in a time sequence to meet the water quality needs for water uses; (4) a summary of water quality goals for specific water uses in terms of values and ranges for specific locations; (5) flow regulation required to supplement waste treatment removal facilities, estimated by volume and location in terms of chronological developments; (6) a mathematical simulation of factors relating to water use, waste water, hydrology, chemical and biological responses in the stream; and (7) maps, charts, tables, and graphs depicting the orderly development of water at a given location in association with a given population, industrial expansion and other social and economic factors.

Some of our comprehensive plan projects have been underway now for several years. We are far enough along with several of these programs to have reached some rather clear estimates or conclusions of what needs to be done to attain a projected water quality.

The Delaware Comprehensive Study illustrates these approaches. Within a comparatively short period of time we have obtained from our cooperators, and gathered enough detailed information to enable us to make a precise analysis of water quality problems. Here, for the first time, measurements of waste inflow, water diversion, tidal action, river discharges and quality of water have been utilized to set up a mathematical model of the Delaware River from Trenton to the sea. Given a volumetric set of waste conditions, the model will predict with a high degree of accuracy the quality conditions which will prevail in the river at selected points. Conversely, given a set of quality levels deemed desirable in the river, the model provides a picture of the inputs which must be attained to achieve that level of quality. This particular model incorporates cost data and can select the most economical system of controls which will achieve the quality level sought.

This is not theory. The model has been calibrated and it plays back the situation in the Delaware River accurately. I must tell you, however, that the Delaware River model is indeed free of subjective thought and constraint and that some strenuous efforts will be required to achieve quality goals of relatively mediocre level in heavy population and industrial centers. This achievement gives us a new capability and enables the pre-testing of any set of conditions or assumptions to predict water quality response with a high degree of accuracy.

We will use this tool to test and upgrade each of the basin plans being developed by the ongoing comprehensive water pollution control projects. We will use it further to provide testing service to regulatory and construction agencies, enabling them to make better decisions as to the type and kind of waste effluents which can be successfully transported out of the area via the natural waterways.

When the planning phase of the Comprehensive Water Pollution Control Program has been terminated (a 3-7 year effort) each project's staff will be reduced to a surveillance group charged with keeping the plan in concert with developments in the basin and providing the testing services which the simulator or basin model provides. We do not intend to let this program sit on the shelf as a fine but impotent report. We will want to continue discussions with you concerning the appropriate means for implementing these programs. This question is not yet settled in many respects--the next paper will discuss the compact approach.

This approach to a comprehensive water pollution program planning for a river basin is proving most satisfactory to those of us working in this field. However, its implementation and operation depend on very close cooperation and coordination among water resource and pollution control agencies--Federal, Interstate, State, and local. I see emerging from these efforts a very much advanced concept of water pollution control administration for all interests--government and industry.

If our Nation's water resources are to be developed economically and efficiently, if we are to satisfy conflicts between water use interests, and if we are to provide good quality water, then we must plan wisely and well. I believe we are off to a good start.

IMPLEMENTATION OF A COMPREHENSIVE PLAN FOR THE DELAWARE RIVER BASIN

by

James F. Wright*

Introduction

The establishment of the Delaware River Basin Commission in the Fall of 1961 was the culmination of lengthy and diverse efforts to obtain a unified basinwide approach to the development of the Delaware's water resources. Attempts to achieve formal interstate action through the compact medium were made as far back as 1923. From 1937 until its functions were transferred to the new Commission, interstate cooperation in the water resources field primarily revolved about the Interstate Commission on the Delaware River Basin (INCODEL). INCODEL was not based upon a compact but was created as a joint advisory board by the four basin states (New York, New Jersey, Pennsylvania, and Delaware) and it operated on the principle of voluntary interstate cooperation.

INCODEL's main activity was in the pollution control field and it was successful in promoting uniform prosecution of these programs among the States. Its plan a decade ago for a compact between the States to comprehensively develop the basin's water resources failed by the thinnest of margins -- one vote in one house -- to obtain unanimous approval. The disastrous hurricane floods of 1955, however, dramatically demonstrated the urgent need for a basinwide attack, and the Army Corps of Engineers was directed by Congress to formulate a comprehensive plan for the development and control of the Delaware's water.

The Corps completed its report in December 1960. It advocated a 50-year development program comprising 58 water control projects at a total cost of $591 million to reduce flood damage, augment stream flows, and increase water supplies. During the survey period the legislative and governmental aspects of basinwide planning were being considered by the Delaware River Basin Advisory Committee composed of representatives of the States, New York City, and Philadelphia. This Committee proposed an equal rank Federal-State compact which was approved in the record time of eight months by the States and Congress and signed by the late President John F. Kennedy on September 27, 1961.

Under the compact, the Delaware River Basin Commissioners are the Governors of the signatory States and an appointee of the President. The present Federal member is Secretary of the Interior Stewart L. Udall. Each of the Governors and Secretary Udall has a voting alternate to handle the month-by-month policy chores of the complex Federal-Interstate operation. The full-time staff of the Commission is made up of 37 employees and includes specialists in water supply, pollution control, water and land use, recreation, flood control, hydroelectric power, and other fields of river management.

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*Executive Director, Delaware River Basin Commission

Powers and Duties of the Commission

The compact charges the Commission with the development and implementation of plans, policies, and projects relating to the water resources of the basin. It says the Commission "shall adopt and promote uniform and coordinated policies for water conservation, control, use, and management in the basin." Further, "It shall encourage the planning, development, and financing of water resources projects according to such plans and policies."

The compact provides the framework for these activities by directing the Commission to formulate and adopt a comprehensive plan for both the immediate and long-range development of the basin's water resources and a water resources program based on the comprehensive plan which shall be a presentation of the facilities and projects -- both public and private -- required for balancing water resources supply and demand.

A major tool by which the Commission expects to promote uniform and coordinated action within the basin is its review power granted in Section 3.8. The Commission is directed to review all proposed projects "having a substantial effect on the water resources of the basin." The criteria established for these projects are that they should not "substantially" impair or conflict with the comprehensive plan. Rules and regulations regarding applications and review procedures are currently being developed. Upon approval by the Commission, they will be the subject of a public hearing before final adoption.

Also crucial to uniform and coordinated action on the basin's development are intergovernmental relations. To avoid jurisdictional conflicts and to give full effect to the Commission as a regional agency, ground rules for such relations are established in Article 11 of the compact.

The Commission is authorized to seek outside guidance by forming advisory committees which may be composed of representatives of the public, federal and local governments, labor, agriculture, water-using industries, and other water-interest groups. Permissive powers of the Commission with respect to pollution control are reserved for later discussion.

The Comprehensive Plan

The heart of the Commission's program is the comprehensive plan. Its purpose, as set forth in the compact, is to provide an established framework of Commission policy for the immediate and long-range development and use of the basin's water resources. The completed plan will include all public and private projects and developments required for optimum water resource use.

The Commission formally adopted phase one of the plan in March 1962 following a public hearing. This first phase is limited to those projects and facilities which appear justified on the basis of existing studies and information and are compatible with the purposes of the compact. This current plan comprises 12 large multi-purpose reservoirs and 8 local watershed conservation projects. The 12 major reservoir projects, including the $122 million Tocks Island Reservoir on the main stem of the Delaware, were recommended in the Corps of Engineers' report. Eight of these containing federal aid flood control features already have been authorized for probable construction by the Corps. The projects authorized by Congress all include major recreation and water supply features as well as flood control and are to be completed within 25 years. Two of these reservoirs have already been constructed by the Army Engineers for flood protection and are to be enlarged for water supply and recreation.

Upon completion, the 20 projects will provide a net yield which will approximately double current minimum flows. The reservoirs will also provide recreation capacity in excess of 15 million visitor days annually. The projected cost of all the projects now in the comprehensive plan is $340 million, of which about 53 per cent is to be raised from non-federal sources. The balance of the costs, $160 million, will be borne by the federal government.

The comprehensive plan has been enlarged to include Cannonsville, a New York City reservoir under construction, and also existing water supply and waste disposal installations, and recreation areas. The Commission has adopted on an interim basis the INCODEL water quality standards promulgated more than 20 years ago and which have been the basis of the individual States' pollution control programs in the basin.

Water Resources Program

The Commission staff has recently completed its first annual water resources program and it will be the subject of a public hearing soon. The compact directs the Commission to adopt each year a water resources program, based upon the comprehensive plan, consisting of the projects and facilities which the Commission proposes to be undertaken by the Commission and by other authorized governmental and private agencies during the ensuing six years.

The water resources program includes a systematic presentation of (1) the quantity and quality of water resources needs for such period, (2) the existing and proposed projects and facilities required to satisfy such needs, including all public and private projects to be anticipated, and (3) a separate statement of the projects proposed to be undertaken by the Commission during such period.

The material developed for this report shows that substantial volumes of surface storage must be created at strategic locations in the basin to increase low flows for improvement of water quality, and to decrease flood stages. The increase in water demand expected between 1963 and 1968 -- the period covered by the first program -- is more than 800 million gallons per day. The report also concludes that more efficient use should be made of the natural ground water reservoirs in the basin. The potential yield from these sources appears to be about 800 million gallons per day, although considerable research into the interrelationships between the aquifers of the coastal plain and surface streams are required before more accurate forecasts can be made.

The staff recommends that the Commission give its full support to the financing and early construction of five of the multi-purpose reservoirs contemplated in the comprehensive plan. Also, that the Commission endorse the general principle of early acquisition of lands needed for future water projects in the interest of site preservation and interim use for recreational purposes. With respect to water quality, the staff believes that the Commission should seek compliance by the basin states with the INCODEL standards.

The five projects endorsed for construction will help to alleviate the immediate needs demonstrated in the program. Collectively, these projects will contain 482,000 acre feet of usable storage dedicated to water conservation; they will provide 333,000 acre feet of flood control storage resulting in an average annual benefit from flood damage reduction of more than $2 million; they will provide 1150 CFS of low flow augmentation for water quality control, water supply, and improvement of fish habitat; and finally, they will produce for our fellow citizens almost nine million water-associated recreation days.

Water Quality Management Program

The Commission's unique powers afford it an opportunity to fulfill the compact's charge to develop the basin's water resources in a manner that "will bring the greatest benefits and produce the most efficient service in the public welfare." The staff thus intends to explore all likely alternatives for deriving the greatest net benefit from the area's water resources.

Powerful tools for assisting the Commission in attaining its objectives are expected to develop from the Delaware Estuary Comprehensive Study commented on by Mr. Krause. The study is hopeful of producing methods for the accurate appraisal of estuary water quality. These techniques would include procedures for short and long-term quality forecasting, and methods using computer-based optimization studies for evaluating the various technological alternatives that may be available. The aim is to develop basic cause-and-effect relationships affecting the water quality in the estuary and to rationalize the cost of improving present conditions against the resulting benefits. Commission representatives are participating in the study through membership on both the policy advisory and technical committees.

The policy advisory committee, composed primarily of Administrators, was organized by the Public Health Service to provide advice and guidance so that fruitless effort might be minimized. The technical committee is made of representatives of those agencies which are participating in a significant portion of the study and serves as a sounding board for the technical aspects of the work involved.

Returning again to the comprehensive plan, the multi-purpose reservoirs proposed therein are expected to be of significant assistance in establishing and maintaining desired water quality in the basin. Since these facilities will not be completely operable for some time, the interim quality control program will have to rely most heavily on conventional pollution abatement methods. The Commission is again fortunate in that it can utilize well advanced regulatory programs in the signatory States in developing a comprehensive quality management program. Per capita expenditures by the signatory States for regulatory activities are well above the national average, and in the State of Delaware are the highest in the country.

The compact grants the Commission broad permissive powers with respect to pollution control. It says the Commission may "undertake investigations and surveys, and acquire, construct, operate, and maintain projects and facilities to control potential pollution and abate or dilute existing pollution of the water resources of the basin" and that it may "invoke as complainant the power and jurisdiction of water pollution abatement agencies of the signatory parties." The standard of control to be used by the Commission is that "Pollution by sewage or industrial or other waste originating within a signatory State shall not injuriously affect waters of the basin as contemplated by the comprehensive plan."

To effectuate control, the Commission is empowered, after a public hearing, to "classify the waters of the basin and establish standards of treatment." The compact adds that these standards should allow "for the variable factors of surface and ground waters, such as size of the stream, flow, movement, location, character, self-purification and usage of the waters affected." This indicates that the compact framers favored a stream classification approach.

Each of the signatory parties has agreed to enact any necessary legislation to enable it to place and maintain the waters of the basin in a satisfactory condition. Satisfactory condition is specified in the compact as being "available for safe and satisfactory use as public and industrial water supplies after reasonable treatment, suitable for recreational usage, capable of maintaining fish and other aquatic life, free from unsightly or malodorous nuisances due to floating solids and sludge deposits, and adaptable to such other uses as may be provided by the comprehensive plan."

Finally, the Commission may, after investigation and hearing, issue pollution abatement orders against any entity in the basin violating promulgated standards. It may bring an action in its own name in a signatory court of competent jurisdiction to compel compliance. The compact directs the Commission to utilize existing agencies and it is hopeful of meeting its obligations to the basin in this field primarily through the medium of State regulatory action.

I would like now to discuss briefly some of the present and proposed activities of the Commission, with respect to water quality management:

A. Basic Data Program. Since an essential aspect of long-range planning is an accurate appraisal of existing conditions, the staff is giving high priority to the establishment of a basic data program. Initially, this program comprises two basic parts:

(1) Inventory of withdrawals and return flows, and

(2) Stream quality data.

Information for the inventory is being obtained from various sources, including industrial water use questionnaires, State Health Department records, and routine inventory data distributed by the Division of Water Supply and Pollution Control of the U. S. Public Health Service. Considerable data will also result from the abatement status survey that I will describe in a moment.

With respect to water quality data, the staff is critically evaluating current sampling programs (at present eight agencies are collecting quality data in various parts of the basin) with a view towards possibly improving the over-all efficiency and meaning of the work. Close contact is being maintained with pertinent developments in the automatic monitoring and data transmission fields for their possible application to Commission operation. Also, procedures are being established for maintaining all data in a form suitable for computer tabulation and analysis. To facilitate this and other possible computer programs, the Commission has engaged an expert in the field.

B. Pollution Abatement Status Survey. As mentioned previously, the Commission has adopted the INCODEL standards on an interim basis. The staff is attempting to ascertain, therefore, the present level of compliance with these regulations for the long-range objective of determining their adequacy. The assistance of the individual States is being sought in this work, which will include review of status reports in regulatory files and possibly performance audits at larger waste treatment installations.

The staff also plans consultation regarding possible administrative improvement of the INCODEL standards. The purpose of this study would be to obtain a more uniform application of the standards among the States and initiate preparations for such revisions as appear necessary.

This group assembled here today may be interested in the Commission's position with regard to the water quality standards provision of U. S. Senate Bill 649, on which House hearings have been scheduled for this and next week. At its October 22 meeting the Commission adopted a Resolution declaring as follows:

"The Delaware River Basin Commission memoralizes the Congress to modify the provisions of S. 649 so as to give full effect to the purposes of the Federal-State partnership which established this Commission. To that end, the Commission, as a Federal-Interstate Agency charged with the comprehensive development and control of the water resources of the Delaware River Basin, should be acknowledged in the Bill as the Agency established by previous concurrence of the Congress to promulgate standards in the basin: and, accordingly, the authority of the Secretary under Section 10 of the Bill should not extend to ... (the Delaware) basin."

C. Research Studies. The Commission expects to both sponsor and conduct basic research on water quality-usage relationships. One planned study would determine costs incurred by industrial and municipal water users due to quality impairment. The information developed should be useful in evaluating the economics of water quality control proposals.

A contract study to establish the effects of water quality on present and potential recreation demand in the Delaware estuary is also being considered. It would be aimed explicitly at including water quality in the recreation valuation problem. The results of this work and other studies on the economic aspects of water quality are basic data needed for the computer simulation of optimum water resource systems.

In summary, may I say again that, while the problems facing the Delaware Basin Commission are numerous, our plan of action is designed to meet these problems on many broad fronts, and to provide equitable solutions in proper sequence so that the greatest net benefits will be achieved throughout the basin.

ROLE OF THE PUBLIC HEALTH SERVICE REGIONAL LABORATORIES IN WATER QUALITY AND WATER RESOURCE MANAGEMENT

by

Gordon E. McCallum*

Your program chairman has asked me to explain the Role of the New Regional Water Pollution Control Laboratories. This I am pleased to do.

As you know, the original Federal Water Pollution Control Act set forth specific responsibilities in research. But, like some of the Act's other authorizations, research for a long time was not given a very important place in the annual appropriations.

During the 1950's the total amount spent for this item in water pollution control from all sources--Federal, State, universities and industry--averaged less than $4 million a year. In our Federal program, --such scientific investigations as we were able to carry on --were on a piecemeal basis --often interrupted by the emergency "fire-fighting" --so familiar to us all.

True, we had established in the 1950's the excellent facilities at the Sanitary Engineering Center in Cincinnati, but this single research center has never been able to serve the far reaches of the country. Technical services from the Center have served largely an area within a 500-600 mile radius. And laboratory space at the barely 10-year-old Center is already "bursting at the seams." Just in the last two years the water pollution control program has had to establish two ancillary laboratories in the Cincinnati area for lack of space at SEC.

And over the country at large we have been forced to establish some 17 temporary laboratories. These are facilities for the most, to support such activities as enforcement and comprehensive programs.

I hardly need remind this group that as public pressure built up prior to the 1961 amendments - to the Water Pollution Control Act - the research need was stressed time and time again. This was manifested in Congressional hearings; in the 1960 National Conference on Water Pollution; and in the 1961 report of the Senate Select Committee on National Water Resources.

One of your own group - Milt Adams of Michigan - testified to Congress that research was "generally accepted as the non-controversial part of this proposed legislation." He labelled the regional laboratories as "part and parcel" of the need for more and better or less expensive remedies for controlling pollution.

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Thus, it came as no surprise when Congress, in the 1961 amendments, authorized seven regional laboratories in language which does not limit these facilities to that number. The Act states:

> "The Secretary [of HEW] shall establish, equip, and maintain field laboratory and research facilities, including, but not limited to, one to be located in the northeastern area of the United States, one in the Middle Atlantic area, one in the southeastern area, one in the midwestern area, one in the southwestern area, one in the Pacific Northwest, and one in the State of Alaska, for the conduct of research, investigations, experiments, field demonstrations, and studies, and training relating to the prevention and control of water pollution."

The Act further stipulates that "insofar as practicable, each such facility shall be located near institutions of higher learning in which graduate training in such research might be carried out."

One year later, in the appropriations act, Congress provided for two more water laboratories, of a different type. These are to be national water quality standards research centers - one for developing criteria for fresh water uses - one for salt water uses.

Thus, we are now faced with the task of building, equipping and staffing nine new laboratories in various parts of the country - over the next few years. Each of these facilities will cost, fully equipped, about $2.5 million. Much has already been accomplished in architectural planning and site acquisition. All sites for the new laboratories have been donated to the Government.

The staffing, as you might suspect, will be a formidable task. Our present research staff consists of engineers, bacteriologists, biologists, chemists, epidemiologists, hydrologists, limnologists, mathematicians, oceanographers, economists, mycologists, soil scientists, virologists, etc. And who knows at what rate we may be applying the social sciences to the solution of water pollution problems. By a major effort, we believe we can attract the talent we will need. Let me answer one question before you ask - we have no intention of raiding the States!

Gradual recruitment of scientific and technical personnel has been going on over the past two years. Nucleus staffs are already being assigned to temporary offices at East Central State College, at Ada, Oklahoma; Oregon State University at Corvallis; and the

University of Georgia at Athens. Other regional sites include: Fairbanks, Alaska; Ann Arbor, Michigan; and the Jamaica Plain sector of the Boston, Massachusetts area. The Mid-Atlantic site has not yet been selected.

The national fresh water quality standards laboratory is to be at the University of Minnesota Campus in Duluth; the salt water facility at the University of Rhode Island in Kingston.

Present plans call for actual construction to begin on the Oklahoma, Oregon, Georgia, and Alaska projects early in 1964 - and the others later in the year or by the first of 1965. We believe the Oklahoma facility will be the first to open, about April of 1965, followed closely by the others. Contingent upon appropriations, we plan to have all nine laboratories, regional and national, completed by mid-1966.

Staffs at each of the regional installations, except Alaska, will number about 150. In Alaska we anticipate a staff of about 60, and here we may undertake a more basic type of program. In Alaska we will be concerned with projects in the Arctic environment. At the two national water quality standards laboratories we will employ from 100-120 people. About two-thirds of the staff at each installation will be scientist and engineering personnel. The others will be supporting staff, to be recruited locally, where possible, through the Civil Service system.

Already we have held regional meetings--in the Southwest, and in New England--toward a preliminary identification of the research needed in those two regions. Close working relations have been developed with the Committee on Institutional Cooperation, representing the Big Ten Universities and the University of Chicago in the Midwest. This Committee is helping to identify the needs of its region in the programs we will conduct at the Ann Arbor regional laboratory. We have had various communications and meetings with the CIC. Through this medium we shall attempt to develop the closest working relations with all of the universities in this organization. Our experience here may serve as a prototype for other parts of the country. As I told the Senate Appropriations Committee two years ago - "I am convinced that this type of cross-fertilization between a Federal agency and institutions of higher learning will pay off."

In the Pacific Northwest, our own regional office at Portland, with the aid of the Pacific Northwest Pollution Control Council, has put together an excellent prospectus of research needs for that area.

There have already been identified more regional research problems and studies than we will be able to undertake.

If your friends in the universities are apprehensive that the Federal government is moving in on research which may more properly be done in the universities, you may assure them that nothing could be further from our thoughts. The pressure for solutions to immediate problems associated with our own direct operations are so great, and will continue to be so great, that we could never undertake all of the fundamental types of research that the universities are especially qualified to do.

I would like to cite actual data indicating how our grants-in-aid program is contributing support to the research and training programs of universities. In 1963, we awarded 184 research grants, 14 demonstration grants, 35 training grants, and 45 research fellowships. The 278 grants of all types amounted to more than 5 million dollars ($5,185,000). These grants and awards were distributed within 109 different schools and departments in 42 States.

Research grants are expanding research activities throughout the country and are encouraging investigators to undertake research in neglected areas. These projects employed over 300 students to conduct studies in many areas of needed research. Training grants and research fellowships support the graduate training of specialized research, engineering, scientific, and administrative personnel. They support the improvement of teaching staff and the training of more than 200 students, principally sanitary engineers, but also specialized scientists in the biological, physical, and social science fields. So that in total we are providing support for more than 500 graduate students in the water pollution control field.

As I see it, one of the functions of our scientists at the regional laboratories will be to encourage departments in the various schools--schools not heretofore concerned with water pollution control--to apply for research grants, demonstration grants, and training grants, or to assist students in applying for research fellowships. In this way, we can continue to bring new brain power and skills to our many unsolved, and emerging new problems.

So, the new regional centers will be more than laboratories and research facilities, per se. They will serve somewhat as the Sanitary Engineering Center at Cincinnati has - as focal points for training, for demonstrations and pilot plant studies, and for technical and scientific assistance.

From 1958 through 1963, more than 1200 trainees have attended our water-related SEC courses. These, as you know, are presented as advanced training for engineers, chemists and other scientists from Federal and State agencies, municipalities, and industry. The number of applicants has grown each year. When the regional laboratories are opened, they will be utilized to encourage and expand this type of training, so that it will be more readily available to more people.

In summary, then, the regional laboratories will be responsible for planning and administering a regional program including: (1) water pollution research; (2) support of graduate and other training; (3) demonstration and pilot plant studies; and (4) selected technical and scientific assistance to our own programs and to other Federal, State, interstate, and local agencies.

Our policy--and funding limitations--dictate that major emphasis be directly related to water pollution research. This, of course, can involve many aspects of the water resource when viewed in terms of the Water Pollution Control Act itself - since the Act clearly sets forth its objective "to conserve waters for public water supply, propagation of fish and aquatic life and wildlife, recreation purposes, and agricultural, industrial, and other legitimate uses."

While the laboratories will be primarily concerned with regional problems, they may at times undertake problems of national significance, depending upon the research competence within the individual laboratory. We will avoid duplication. Insofar as the day-by-day situations in each part of the country are concerned, we will have brought research resources closer to you.

Now, a word about the two national water quality standards laboratories. As you gentlemen well know, few of the standards in use today are based on scientific facts. Rather, they represent judgment and opinion, and they range from a minimum requirement of primary sewage treatment to complex systems of stream classifications and water quality standards. We as administrators, are constantly being called upon to make decisions whose validity depends upon data of questionable scope and reliability. Each year your agencies have called increasingly upon the Service for technical assistance in evaluating or establishing water quality standards with respect to specific pollution problems. A growing number of national conferences and organizations have urged and recommended that a scientific program be undertaken to develop better water quality criteria.

The two national laboratories at Duluth and Kingston will be especially designed for this purpose. The staffs at these two places will work closely with industry, agriculture, conservationists and State and local government. They will review, store and arrange retrieval systems for all pertinent research; they will evaluate existing standards; they will develop a reliable methodology to detect and identify pollutants and to measure their effects on water uses; and they will begin to develop water quality requirements for all water uses.

In closing, I might dramatically envision coming out of our new system of laboratories scientific discoveries of which we have not yet dared to dream. In a more practical sense, however, I am going to say that the nine new establishments simply will be a more efficient bulwark against the very short time when we must use and reuse our limited water supply much more extensively. There may indeed be drama along the way at Ada, Athens, Corvallis, Duluth or the others--but mostly there will be the hard and dedicated work of the white-garbed specialists at the laboratory benches--going about their traditional trial-and-error sifting and resifting of methods - to help find feasible ones by which this nation can better meet its growing water needs.

DU PONT EXPERIENCE WITH ENGINEERING TECHNICIANS

by

L. A. Darling*

Introduction

The purpose of my appearance before you today is to give you as much insight as I can regarding our experience with engineering technicians in du Pont's central engineering department, particularly as this experience may relate to your requirements. Your basic question, as I understand it, is whether engineering technicians can be used effectively in the technical aspects of your work to supplement the work of your engineers and improve their effectiveness.

Engineering Department Approach

There are 517 engineering technicians employed in our engineering department, of whom 160 are technical institute graduates. Fairly sizable numbers are employed elsewhere in our company, but because I am more familiar with the situation within the engineering department and because I believe our needs are closer to yours, these remarks will be primarily concerned with our experience within the engineering department.

About the close of World War II, we in the engineering department recognized that a gap was developing in the technical communication between our engineers and our craftsmen, particularly in the engineering development laboratory. This laboratory initiated a program to develop an intermediate level which they called technicians. Candidates for development to technician level were selected from within the laboratory force and by employment of high school graduates and young men with incomplete college education. The development program included organized on-the-job training and night school and extension courses which were applicable to their work.

While this program met with a fair degree of success, it became apparent by 1958 that something further was needed. So initial selection techniques were developed which resulted in more highly qualified new employees. Technical institute graduates were found to meet these higher standards of selection better than those from other sources.

In 1957 our design division began hiring technical institute graduates as draftsmen. These young men surprised us by how quickly they became productive members of the design team.

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As you may have gathered, our concept of the proper role for our technicians went through a process of evolution from 1945 to the present. During this period there has also been a steady evolution in the training given to engineering technicians by the institutes. By 1961 it was clear that our best source of engineering technician talent was in the technical institute graduates. A survey of institutes in our part of the country was initiated and liaison established with several which were accredited by the Engineers Council for Professional Development.

Engineering Technology Education

An examination of the entrance requirements and study courses of an engineering technology curriculum will, I believe, suggest to you the level of competence which our recent graduates have displayed after they have been with us a few months.

A recent investigation by the American Society for Engineering Education gives an authoritative picture of present-day engineering technology education. The following are excerpts from a report of J. L. McGraw of the University of Dayton, who directed this ASEE Technical Institute Evaluation Project.

Faculty

"A satisfactory engineering technology faculty should be composed of people who understand what they are trying to do. They know that they are not teaching in an engineering program but they know also that they are not teaching in a trade school."

"Since engineering technology curricula are so closely related to engineering, a satisfactory engineering technology faculty should contain a substantial proportion of graduate engineers."

The Engineering Technology Student

"First of all, he is a high school graduate. This is a normal requirement for admission. In addition, he normally must have had three years of high school English, two years of high school mathematics, one in algebra, one in plane geometry, and additional units if possible.

"He must also have had one year of high school physical science with laboratory, preferably physics or chemistry."

"Many of these courses he should have taken in high school are identical with the courses that engineering colleges desire."

Curriculum

"... the engineering technology curriculum differs significantly from the pre-engineering curriculum which is in effect the first two years of a baccalaureate engineering program. The two years of the pre-engineering curriculum are devoted primarily to mathematics, basic science and general education. They contain relatively few specialized technical courses. An engineering technology curriculum, on the other hand, must introduce specialized technical courses early in the program if it is to produce a competent technician within the short span of two or three academic years."

"Curriculum length in existing technology programs varies from two academic years to three calendar years. The typical program is probably 72 to 75 semester credit hours in length and extends over two nine-month academic years. For purposes of this study the Committee has divided the curriculum into three major sections: Basic science courses, which include mathematics and physical sciences; technical courses, which include technical skills and technical specialties; and non-technical courses, which include communications, humanities, and other life-oriented courses."

Basic Science Courses

"To promote versatility and future technical growth of engineering technicians and to minimize the risk of technological unemployment because of obsolescence of their technical knowledge, the Committee recommends a substantial program in mathematics and the physical sciences."

"The Committee recommends that mathematics taught in the engineering technology curriculum should be of college level."

"Mathematics programs should include carefully selected topics from such areas as analytic geometry, differential calculus, integral calculus, differential equations, probability and statistics, vector algebra, and Boolean algebra. The selection of topics will, of course, depend on the curriculum."

"Physical sciences should be taught in separate courses from the technical specialties. It is believed that this will provide the student with a broader foundation of knowledge for future growth since instruction will not tend to be as limited in scope. The curriculum should contain at least a one-year sequence (six semester credits) in the physical sciences at the college level. Physical science courses should be accompanied by appropriate laboratories."

Non-Technical Courses

"... the Committee recommends that as part of both his occupational and cultural development the engineering technician's education should include instruction in linguistic communication, humanistic-social studies and other appropriate non-technical studies. A minimum of 15 semester hours should be devoted to these non-technical subjects."

Technical Courses

"For purposes of this study, the Committee has divided the technical courses into two groups, the technical skills and the technical specialties."

"Technical skills are characteristic of the engineering technician. While development of a high degree of manual skill is not the principal objective of the engineering technology curriculum, it is apparent that the engineering technician's education must include instruction in the art and practice of engineering. This is especially true as these subjects are de-emphasized in the engineering curriculum to make room for more advanced engineering science."

"The technical specialties are always in transition. What today is an innovation in professional engineering design or methodology, tomorrow becomes the established engineering practice falling within the province of the engineering technician. The course content of the technical specialties, therefore, cannot be permanently established."

"Since engineering technology curricula are inherently specialized, it is the Committee's opinion that 30% to 50% of the total credits (comprising not less than 24 semester credits) should be devoted to courses in the technical specialties."

"Courses in the technical specialties should include considerable attention to problem identification and solution. They should emphasize the quantitative, analytic approach rather than be limited to the descriptive."

"Laboratory instruction coordinated with the technical specialties courses is an essential part of any engineering technology curriculum. An important feature of the laboratory experience is the acquisition of familiarity with the techniques and instrumentation used in the measurement of physical phenomena. The student must be given the chance to learn and practice the collection, analysis, and presentation of data."

Engineering Department Experience

Our experience with newly graduated technicians is that they very quickly become productive, with only a moderate amount of supervision and assistance from our professional engineers. This is fortunate, as a hard-pressed engineer working on a tight schedule might feel that he could not spare the time to give these new men the guidance they need initially if the return for his effort were long delayed.

In our design division we have recent graduates in mechanical, civil, electrical, and electronic technology working as draftsmen. Some earlier graduates have advanced to the grade of Designer or Senior Technician.

In our engineering test center, engineering technicians are setting up apparatus or hardware for tests of equipment or processes used in our industry. These are in great variety and range from chemical unit operation to electrical equipment and electrical automatic control devices. Working under the supervision of engineers, new men soon advance to the point that they can set up the tests and record the data. Other technicians operate our high-speed, high-capacity digital computer and set up our analog computer to simulate a mathematical model furnished them by our engineers and mathematicians.

In our engineering development laboratories they are working as draftsmen, designers, in procurement of material, scheduling of shop work, testing of subassemblies, and initial operation of completed units of the special machinery developed and built there.

As a recent example of the rate of progress we have experienced, I will cite one in our engineering development laboratory. A young technician, 18 months after graduation, was given a few rough sketches and some letters and verbal description on the design of a new kind of machine by the engineers. He was instructed to prepare detailed drawings and make an estimate of cost with a forecast construction schedule. The technician did this and arrived at an estimate of $50,000. After review of his drawings and estimate with the engineers responsible, he was told to go ahead with construction and complete it as quickly as possible. He wrote the work orders and transmitted drawings for parts to be made in our shop. He issued requisitions and made contacts with vendors of parts which were to be purchased. He prepared the assembly schedule and supervised the assembly of the machine in the test area. He put the machine into operation, conducted the test, recorded the data, and prepared the report with only minimum supervision by the engineer in charge of the project.

Another example is the senior technician in our engineering service division who is on call to our plants in different parts of the country when unusually stubborn problems develop in an automatic control system. He has taken responsibility for corrective measures when the accuracy of his diagnosis and the success of his course of action was vital to the output and perhaps to the safety of a multi-million-dollar installation. He has done this when his supervision was hundreds of miles away and not in a position to double check his diagnosis.

We find that individuals like this with long years of experience in their field are likely to be more competent in their specialty than an engineer with less experience. One reason is that engineers usually would not be satisfied to concentrate on this kind of specialty for so long a time.

Technicians in Water Pollution Control

The question remains: "What can be expected from engineering technicians in water pollution control?"

I would be over presumptive to claim that I know the answer. But from my contacts with water pollution work over a good many years and our recent experience with engineering technicians, I can give you a reasonable expectation of what kind of work they could do and be trained to do in your field.

If it were my problem I would try to recruit chemical technology graduates from one of the four accredited institutes which offer this course. I know of no technical institute curriculum in Sanitary Engineering and assume that a graduate in chemical technology is about the closest approach to your specific needs that can be found. The chemical curriculum does not include biology and biological laboratory procedures, so it will be necessary for a graduate to acquire this knowledge. However, these men are good students and are schooled in laboratory technology, so rapid progress can be expected.

How rapidly will these graduates become productive?

From our experience I would say that he can make fairly sophisticated chemical analyses the day he arrives. With a few hours' training and a little follow-up supervision he should be running bacteria counts and BOD within a week. He would be able to get your stream samples after you have shown him one time where and how.

With a year's experience I would expect him to set up an ordinary stream sampling station or sampling program, take the samples, do the lab work and report the results with only normal supervision from an engineer. Within five years I would expect him to do about any technical procedural work associated with your field. He should be qualified to design and conduct any ordinary type of sampling program and report results in a way that would "stand up" in court.

If there is to be any appreciable demand for technicians in your field, it would be my suggestion that a few selected institutes be approached with a request that they set up a curriculum in Sanitary Engineering Technology. This would resolve any question of the adequacy of their foundation in biology and biological laboratory procedures. It should also include a good foundation in water purification technology and biological treatment of waste, both of which are important to your work.

Our experience in the early days when we were starting with high school graduates and depending upon night schools to give our trainees the basic training in science, suggests that your best source of technicians will be the technical institute graduate. We still hold the door open for outstanding individuals who are not technical institute graduates. If they can acquire the knowledge and skill some other way, that is "fine", but we have found their number is small -- much fewer than our needs.

Pay and Professional Status

It is our opinion that pay and professional status of engineering technicians should recognize that they are highly skilled people who can and properly should assume important responsibility. It follows that their pay and status should reflect the responsibilities they assume and the contribution they make.

For several years there was a growing concern among engineers and technicians that there was no widely accepted procedure to provide recognition for the technician. Finally, the National Society of Professional Engineers undertook leadership in a move to meet the need.

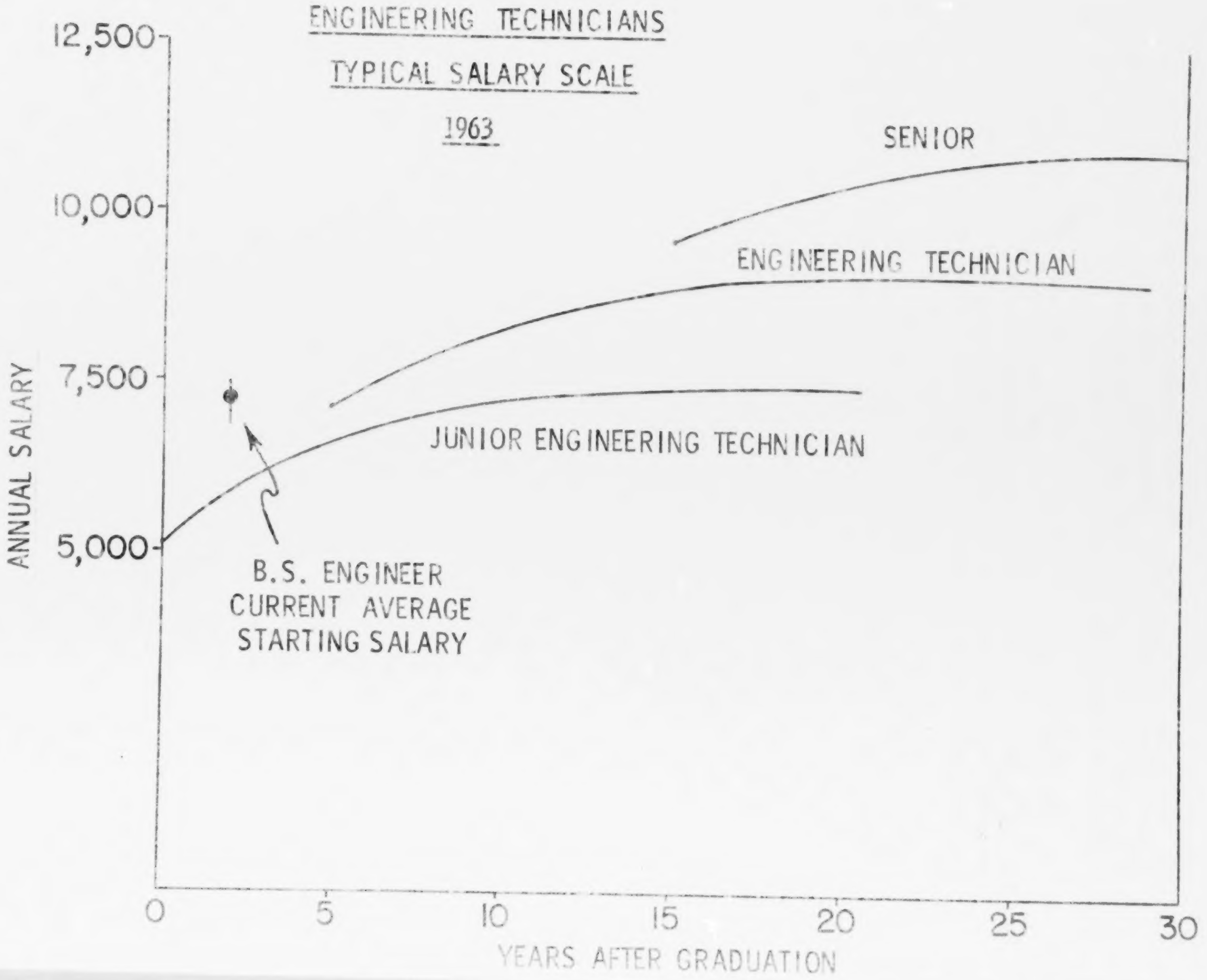
In 1961, NSPE sponsored the Institute for the Certification of Engineering Technicians, with headquarters in Washington, D.C. This institute is an examining body to determine the competency of those who apply for certification. We consider it important that our engineering technicians be certified and encourage them to seek certification.

The Institute recognizes three grades or levels of competency:

Junior Engineering Technician
Engineering Technician
Senior Engineering Technician

The attached chart of engineering technicians' typical salary scale gives you a picture of current salary scales based on the three grades of competence.

However, it must be recognized that, in addition to adequate salary, the kind of man who completes a course in engineering technology usually seeks other kinds of satisfaction. He is almost certain to be a highly motivated individual, which means he has energy and ambition. He wants an opportunity to progress financially and in the esteem of his associates,


ENGINEERING TECHNICIANS
TYPICAL SALARY SCALE
1963
12,500
10,000
7,500
5,000
ANNUAL SALARY
SENIOR
ENGINEERING TECHNICIAN
JUNIOR ENGINEERING TECHNICIAN
B.S. ENGINEER
CURRENT AVERAGE
STARTING SALARY
0
5
10
15
20
25
30
YEARS AFTER GRADUATION

his family and his neighbors. He wants, perhaps most of all, job satisfaction or a sense of accomplishment. This desire makes him willing to assume responsibility. It is common practice that Senior Engineering Technicians are classified as exempt.

The final result of bringing this kind of engineering technician into our organization has been to improve the productivity and morale of our engineers by relieving them of sub-professional work. An unexpected bonus has been that frequently the engineering technician does sub-professional work better than it was being done by engineers.

SPEECH

by

HONORABLE JOHN S. MONAGAN*

I am delighted to be here today to discuss with you some of the problems of water pollution control and abatement. As you know, your Association testified earlier this year before the Natural Resources and Power Subcommittee of the House of Representatives, on which I serve, at its water pollution control hearings in Washington. Your Association made a significant contribution to the Subcommittee's record. I hope that my remarks here today will be as useful to you as your Association's testimony has been to our Subcommittee.

The water crisis of the century is not the shortage of water itself, but the shortage of usable, clean water.

Water pollution has become the nation's single most desperate natural resources problem. Almost all of our major streams and rivers and lakes are suffering increasing pollution. This pollution jeopardizes our water supplies, menaces the public health, destroys aquatic life, and disgraces our environment. It is a direct result of rapid growth in population and urban living, plus the unprecedented technological advances of industry in the past two decades.

The impact which the increasing population and the growing urbanization of our country have on our clean water supply can easily be understood in terms of a few figures.

In the 63 years since 1900, the nation's population increased from 76 million to 180 million; new towns and cities sprang up where only farms or wildernesses existed; villages of 3,000 or 4,000 expanded to 50,000 and more; cities of 100,000 are approaching or have exceeded a million in population.

In 1900, the nation's urban population was 30 million. It has grown beyond 125 million in the 60's. By the year 2000, the urban population of the United States may exceed 300 million!

Water pollution control problems caused by the increases in population are already urgent. In the remaining 36 years of this century they will become overwhelming unless a basis for dealing with them is laid today.

The sources of pollution in our nation's rivers and streams are almost innumerable. Untreated wastes are still being dumped into rivers and streams in many parts of the country. Oils, garbage, chemicals, acid drainage from mines, and many other substances, including new chemicals such as synthetic fibers and detergents, pesticides, radioactive wastes, and a number of other items that we could mention, are ruining our waters.

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*Dem., Connecticut, Fifth District, U. S. House of Representatives.

Water demands are increasing every day. Vast quantities of water are required to produce one ton of synthetic rubber, or a ton of high-grade paper, or a ton of cold-rolled steel.

New or developing industries will, within the next few years, more than double the demand for good quality water. We will have to re-use our waters as they pass from the land to the sea, and unless we take bold and concerted action to meet this expanding demand for re-usable water, the United States will, within the next generation, face economic retardation and a resulting impairment of our national strength to an almost unprecedented degree.

The control of water pollution thus involves the health and economic destiny of our entire nation. We have an equally great responsibility to maintain clean waters for recreation, propagation of fish and wildlife, and preservation of the aesthetic beauty of our country.

It was for these reasons that the Chairman of the Committee on Government Operations, the Honorable William L. Dawson, of Illinois, established the Natural Resources and Power Subcommittee of the House of Representatives to make an extensive and intensive inquiry to appraise how effectively Government agencies and others are dealing with the problems of our Nation's increasing water pollution and to determine what can be done to improve the techniques for preventing or controlling the rising pollution levels of so many of our Nation's rivers, streams, and other surface waters.

The Natural Resources and Power Subcommittee has held extensive hearings in Washington, as well as in different regions of the country, including New England, the Middle Atlantic area, the Mid-West, and the Pacific Northwest, and this week in Texas. I assure you that the Congress is deeply concerned about the problems of water pollution.

During these intensive hearings, almost 200 witnesses submitted information. Government and industry representatives, as well as other interested citizens, testified.

While reflecting achievements of State and Federal officials, the testimony before our Subcommittee has revealed the rapidly growing backlog of needs that must be met to carry out successfully a national water quality control program.

Under the Water Pollution Control Acts of 1956 and 1961, much more must be done. New projects are required -- to keep pace with population growth -- in the field of municipal waste collection and treatment. In addition, the testimony before our Subcommittee revealed that there are 15 million Americans today who are not served by any sewers or treatment works. The method of sewage treatment employed today is the same in principle as that used by the Egyptians 2,000 years ago. That is not progress.

Both municipal and industrial wastes have presented pollution problems for some time. The newest pollution problem comes from the fast growing companies producing synthetics and chemicals which find their way into watercourses. These chemicals include pesticides, radioactive materials, detergents, and fertilizers. Testimony showed that many of these chemicals do not respond to biological treatment and that they persist in streams for a long time. They are increasingly troublesome sources of pollution with far reaching and still unpredictable effects on our rivers and streams. Some of these wastes carry both immediate health hazards as well as long-term genetic hazards which have not yet been adequately appraised.

These newer pollution problems, as well as the growing backlog of conventional problems of treating municipal and industrial waste, indicate the compelling need for major new efforts in the reduction and prevention of water pollution. Recently enacted Federal legislation is pointed in the right direction. Yet we are faced with the inescapable fact of the deterioration of water quality, a fact which clearly demonstrates the need for new preventive efforts.

These efforts must be made by the States and local agencies by exercising anti-pollution laws which are available to them and by strengthening those which are shown to be inadequate. In addition to the preventive efforts required through the enforcement of anti-pollution laws, there is a great need for more sewage treatment works to handle effluent from cities, industries, and farms, and for the development of new methods to treat chemical, pesticide, and radioactive wastes.

Though much remains to be learned about many of these problems, water pollution control cannot wait upon the development of all the answers. Our present state of knowledge in many fields is sufficient for the imposition and vigorous enforcement of controls to safeguard the public health and welfare, and to provide for the quality and quantity of water which our rapidly expanding population and economy require.

Among the new pollutants are the hard detergents which are found in most soaps and cleaning solutions. They have been a serious nuisance in a number of streams where the foaming has been excessive. The companies manufacturing detergents have assured us that the chemical formula of their products is going to be revised so that they will be degradable and susceptible to treatment in our treatment plants. This is something that must be done. Legislation is pending in Congress, as we know, to forbid the manufacture and sale of so-called hard detergents. I think that the work of our Subcommittee is going to encourage progress in this area.

I must admit that at times during the hearings it sounded as though we were making no progress at all in pollution abatement. Water pollution seemed to be as bad as it was 50 years ago. At that time we were losing lives from waterborne typhoid; now we are losing lives from waterborne hepatitis.

Perhaps one of the most encouraging parts of the hearings was to learn of the great amount of research that is being done at all government levels, and by industry and other private concerns. I think that this accelerated research and development work now taking place will do great things for the overall pollution abatement program.

The responsibility for research and for the management of water pollution falls on all water users, as well as on local, state, interstate, and Federal agencies. The simple reason for this is that stream flow does not recognize political boundaries. So from the beginning we have recognized that streams transcend local areas and become a national concern. The problem of pollution is so enormous that it is big enough to give everyone a share in its solution.

Water pollution is expensive. It costs the individual, the businessman, the community, the Nation. No one escapes the economic loss brought by the pollution of our most valuable resource.

Some of these losses or damages are evidenced by the additional costs which must be met, such as construction, operation, and maintenance of water treatment facilities.

But the bulk of the costs of pollution cannot be directly tabulated.

How is the impairment to health measured in dollars? Or the loss of recreational facilities, depreciated property values, or the failure of industry to expand?

While these indirect consequences of pollution cannot be expressed in precise dollar terms, they are nevertheless real and constitute a critical barrier to the fulfillment of local and national economic goals.

Pollution control measures alleviate these adverse conditions and produce economic benefits associated with the improved water quality. These benefits are often not apparent to the public, however, because they constitute insurance for future use of water as well as for immediate use.

The taxpayer must realize that while it costs money to prevent or combat water pollution, the return is great in thriving and expanding industry and healthful community water conditions.

Water pollution is not new and the problem has become more serious for three primary reasons: (1) rapidly expanding industry, (2) growing and shifting population, and (3) use of more water per person. The problem of water pollution is more acute in some areas than in others, and is especially severe in some areas. It is the key part of the whole complex problem of wise water use.

We are NOT running out of water, but now and in the future we will have to use our streams more wisely to meet our growing needs.

Although significant progress has been made in managing water pollution, we are not keeping up with growth and demand and we need, therefore, to step up study, research, and all our efforts if we are to head off a very real water supply crisis.

In stepping up these efforts, there are responsibilities facing all of us as water users. We need to work as effectively as we can at the individual and industrial level, and through the most effective agencies we can use at the local, state, interstate and federal levels.

Most important of all, the different classes of water users, including industry, must cooperate to assure that the needs for the differing and sometimes conflicting uses of water are met in a safe and equitable manner.

At the beginning of my remarks I stated that unless a basis is laid now for dealing with the water pollution problems of the next 30 odd years, these problems would be absolutely overwhelming by the year 2,000. A good first step toward meeting the challenge of the year 2,000 occurred on October 16, when the Senate passed a Bill (S. 649) introduced by Senator Muskie to amend the Federal Water Pollution Control Act. The bill would accomplish, in brief, the following purposes:

1. It would express the national policy "to enhance the quality and value of our water resources and...for the prevention, control and abatement of water pollution;"

2. It would establish a Federal Water Pollution Control Administration within the Department of Health, Education, and Welfare to administer comprehensive programs, interstate cooperation, enforcement measures to abate pollution, establishment of water quality standards, and pollution by Federal installations;

3. It would provide for an Assistant Secretary of Health, Education, and Welfare to assist the Secretary of that Department to supervise and direct the administration of that Department's functions related to water pollution;

4. It would authorize appropriation of $20,000,000 annually for 4 years' research and development grants, up to 50% of the estimated reasonable cost of demonstration projects for separating combined sewer systems;

5. It would increase the individual dollar ceiling limitations of Federal grants for construction of waste treatment works from $600,000 to $1,000,000 for a single project, and from $2,400,000 to $4,000,000 for a joint project involving two or more communities;

6. It would authorize an additional 10% in the grant for construction of waste treatment works if the project is certified as conforming with a comprehensive plan for a metropolitan area;

7. It would authorize enforcement measures to abate pollution when any person is prevented from marketing shellfish or shellfish products in interstate commerce as a result of such pollution and action of Federal, State, or local authorities;

8. It would authorize the Secretary of Health, Education, and Welfare, after public hearing and consultation with all interested parties, to prepare and to encourage the development of regulations establishing standards of water quality for interstate waters;

9. It would provide that waste water discharges by Federal installations shall be controlled under permits issued by the Secretary of HEW;

10. It would establish a procedure to evaluate progress in the development of decomposable detergents which will not cause or contribute to the pollution of surface and underground waters, to develop standards of decomposability for such detergents, and to authorize the promulgation of such standards at such time as detergents conforming to the proposed standards of decomposability are generally available to the manufacturers of detergents;

11. It would establish audit procedures concerning expenditure of construction grants;

12. It would state the authority of the Secretary of Labor over labor standards governing construction of federally aided waste treatment facilities.

The Muskie bill, as well as the companion bill which I introduced earlier in the House of Representatives (H.R. 9007), are now pending before the House Public Works Committee, and hearings on these bills will be held this week, beginning tomorrow, December 4.

I do not take the position that our water resources cannot survive without the enactment of each of the provisions in this bill. I have been a legislator far too long to believe that the nation, or its natural resources, will stand or fall on the enactment, or failure of enactment, of a particular provision. But I do believe that taken altogether or singly the provisions of these bills represent a most important and worthwhile effort to meet our water resources problems before it is too late.

Achieving cleanliness in our streams will entail the making of judgments and the weighing of competing factors of economics and the less tangible benefits of recreational, aesthetic, and wildlife values. The lines which must be drawn will vary from area to area, from stream to stream, from basin to basin, and will depend on the varying judgments of many people. There will undoubtedly be disagreements between those who believe in utilizing the full assimilating capacities of the streams, and those who believe that streams are more important for fishing, boating, and swimming. There will be differences between those who believe that water pollution control is solely the job of the locality, the State, or the region, and those who believe that the Federal Government must take an increasingly vigorous role in the control and reduction of pollution.

Our Subcommittee recognizes these many problems and differing points of view. We are examining all the available facts, opinions and recommendations on this subject from every part of the country. We are using them to stimulate action in many quarters. From our findings and recommendations will undoubtedly evolve legislation, executive action, research, and new points of view.

The hearings and investigation by our Subcommittee are not yet complete. I am convinced, however, that the Subcommittee has already created a heightened awareness on the part of government officials responsible for the Federal water pollution control program. It has sharpened administrative practices and stimulated more imaginative and creative policies.

For example, when our hearings disclosed how little has been done to control water pollution caused by drainage of acid waters from both existing and abandoned coal mine works, the Secretary of the Interior gave personal emphasis to create an intensified effort within the Interior Department on that subject. Similarly, as a result of our Subcommittee's inquiry, many federal agencies are now scrutinizing their own waste discharge practices and much progress is being made to reduce or abate their pollutional effects. Various agencies are also examining their statutory authority with respect to water pollution control, and I anticipate that various bills will be introduced to eliminate deficiencies in the existing law on this subject.

The Subcommittee's hearings have also served another significant purpose which, I feel, is all too often neglected -- that of educating the public. The great number of newspaper reports and articles appearing in professional and trade publications regarding the Subcommittee's hearings leave no doubt that we, along with other groups, have made a deep impression on the public conscience. Where before there was apathy, there are now the stirrings of widespread citizen concern over the preservation of our water resources. In a democratic society such as ours, that is the all-important beginning of a solution to a problem.

The Association of State and Interstate Water Pollution Control Administrators has secured for itself, by virtue of its constant and diligent efforts, a vanguard position in the crusade to preserve the nation's water resources. Please accept my congratulations for the work you are doing. I am happy to be associated with you in this great enterprise. I know we will succeed.

IMPROVING THE STATUS OF THE WATER POLLUTION AGENCY IN ITS OVER-ALL RELATION TO STATE GOVERNMENT

by

E. F. Ricketts*

In a few recent encounters with state water pollution control officials, I have sensed that the Muskie bill and its prospective passage may have produced a mood of doubt and concern among some if not a good many of you.

Insofar as this mood may be present and may reflect concern over an enlargement of the federal sphere of action and a diminution of that of the states, I must confess to sharing some of that concern. My interest with water pollution is of course less directly personal and professional than yours, and possibly my perspective of the occasion for this concern is different. For my perspective of the changing balance between the federal and the state governments includes the belief that such changes usually represent some blending of the following circumstances:

1. Because of the income tax amendment of some 50 years ago and the absence of a constitutional limitation on federal indebtedness, the federal government has the means of giving substantial financial support to programs it deems important.

2. The Congress and the federal executive are responsive and representative, even though they respond to and represent different interests from those that manifest themselves in an individual state.

3. Among the problem areas that the federal legislative and executive authorities respond to and attempt to do something about are those associated with (a) the incapacity of the individual states, because of restrictions on their authority to take action on matters outside their boundaries, and (b) state failures to act, because they are unwilling to exercise their authority or because they are making less than fully effective use of the resources at their disposal.

I think that these circumstances are present in some degree in federal legislative and executive support of the Muskie bill. I do not think, however, that the states and their civil subdivisions can in truth be said to have abdicated their responsibilities in this field. Surely such an assertion is belied by the immense accomplishments and the very large and perceptible financial burdens that people in the states and local units have imposed upon themselves, often through popular referenda, to effect these positive results.

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I experience even a sort of resentment over the belittling of state and local accomplishments that some public discussion of the water pollution problem seems to imply. Yet I cannot say that I am sure that all states and local governments are entirely blameless in the present situation. So, while I see the possibility of some pretty unfortunate consequences following eventually from the passage of the Muskie bill, as now seems likely, I hope that this piece of legislation will provoke some serious stock-taking among state pollution control and water resources officials.

I hope that this stock-taking will be undertaken for several reasons. First, the state--and local--interest in controlling water pollution is direct and continuing. Second, pollution control is only a piece of a larger field, that of planning and managing water resources, and this larger field in turn is closely related to land use planning and management, in both of which the state and local interest is at least as great. Third, there is at least a fair chance that future progress in preserving and improving our water resources is less likely to be attended by controversy and conflict, and indeed may even be in all respects more likely, if that progress is sought through continued and substantial state and local participation and principally through state and local agencies. Finally, the very prospect of an enlargement of the area of federal action emphasizes the importance of each state's equipping itself to represent before the federal government with maximum effectiveness the state and local interests and needs that it is in the best position to perceive.

Since I say that each state should examine whether it is doing the best with what it has, it becomes incumbent upon me at least to sketch the scope and nature of the indicated inventory.

Perhaps the focus in this stock-taking that deserves first importance arises from the facts that the control of water pollution is but a part of the larger area of planning and managing the use of water resources, which includes ground as well as surface waters, and that water resource planning and management cannot be isolated from land planning and land use. Consequently, the process of self-examination needs to be broad enough to include not only state agencies and the laws directly applicable to them but the present and potential roles, functions, interrelationships, and financial and other resources of the lesser civil subdivisions.

This broad approach implies the consideration of many more questions than you have time for and it probably would extend to a great many questions that I haven't even thought of. It may, however, be worthwhile to state a few of the questions so as to suggest the scope of the needed inquiry. Such illustrative questions include the following: Have all of the governmental units that have present legal authority to affect the availability, use, and condition of waters been identified? In Illinois, for example, this means some six or eight different agencies of the state government, literally hundreds, and perhaps thousands, of soil conservation districts, drainage districts, sanitary districts, mosquito abatement districts, park districts, forest preserve districts, cities and villages, and counties. Do we know what they have been doing, with what results, and what they intend to do in the future? Is there some mechanism which helps to assure that actions by one unit which will benefit that unit will not harm another, or even that action by one unit for one purpose will be taken with an awareness of its implications for other purposes and for other areas? To what extent may counties be more appropriate governmental units for water planning and use than municipalities and special districts? If they are, what modifications in the power, structure, and relationships of county government are needed?

Passing from state and local government in the aggregate, we come to the structure of state government itself. We all agree, in theory and in principle, that administrative organization should be subject to change to take account of changing needs and the new or altered programs that are created to meet those needs. We can probably further agree that a going organization, with resources of staff, know-how, prestige, and public acceptance should not be discarded lightly or altered radically without good reason.

If we accept the view that changing needs and changing programs should in general call for a careful look at existing arrangements for them, then we should ask ourselves whether this is the case with water pollution control, or as seems more appropriate, with water resources.

State administrative organization for water pollution control and water resource planning and management has long been characterized by a central role for the department of public health and important roles for one or two or even more additional agencies. Generally it is the state health department that has the largest contingent of technical staff and the largest operating budget for dealing with water resources. That this should be the case is not surprising. Over a long period our principal concern has rightly been with bringing into being and assuring the maintenance of safe public water supplies, with principal attention to the sources and treatment of the supplies and the abatement of gross contamination of sources with human wastes.

These historical objectives have largely been achieved, and our public water supply problem is now perhaps more that of moving slowly ahead and maintaining our past progress. The present context is different from that which gave rise to the emphasis upon safe community water supplies. A water system that provides adequate water of sufficient quality to meet all the domestic, industrial, commercial, and irrigation demands now and for the foreseeable future at a "reasonable cost" is not socially efficient if the over-all ground and surface water needs of the area are ignored; if its customers are not informed on water conservation techniques; if local ordinances, regulations, and practices do not assure water conservation; or if waste and leakage are permitted in the distribution system.

A sewage system is not effective if its effluent is discharged into bodies of water that do not have the dilution capacity to receive it; or, even if the capacity is sufficient, if plants discharging into the same body of water do not coordinate their efforts; if possible uses of its effluent for irrigation or industry are not explored; or if technological improvements in the treatment of sewage are not utilized.

A storm drainage system or flood control plan is not effective if all it does is discharge water downstream without considering low flow augmentation of streams, recreational uses, artificial recharge of ground-water reservoirs, or maintaining water supply reserves.

Effectiveness of water resources management cannot be gauged solely by the administration of single or even combined operations. Rather the test is in the over-all utilization of water in all its aspects for the maximum benefit of the people.

If indeed these are our present circumstances, then surely there should be a careful look at state legislation and state administration, with the following kinds of questions being seriously asked. Is the existing legislative framework a hodge-podge of separate enactments, each concerned with a fragment of the total problem but taking insufficient account of the interrelations of those fragments? Is the reporting of the full range of needed information adequately provided for? Is there an effective mechanism for assuring that construction and operational plans for different uses are viewed in a coordinated fashion? Do the existing statutory responsibilities and the different interests of the existing agencies result in competition and rivalry before the appropriating body, or does the legislature receive requests for funds for different agencies that reflect a prior resolution of competing claims? It is in the realm of speculation, but the suspicion is hard to resist that interagency rivalry and competition before the legislature tend to produce both an imbalance in financial support and a basic neglect of the full range of water resource needs.

I have no organizational prescription for any function or group of related functions that I would wish to see applied in all 50 states. There is still a lot of diversity in our federal union, so that it is entirely conceivable that the right solution would give the dominant role to agriculture in one state, to health in another, to conservation in a third, and that in a fourth perhaps the indications would favor the creation of a water resources department at the expense of existing agencies. Each state's solution should be made to fit its own special requirements, and in designing the solution certainly the capacity of health departments to adapt to an expanding concept of public health or of agriculture departments to display a regard for both producer and consumer interests should not be overlooked as important factors in their favor.

The prospect of expanding federal activity demands especially that the states reexamine their personnel situation. Enlarged federal activity means more federal employees--chiefly in the engineering and technical, legal, and administrative occupations. The source of the engineering and technical employees to fill the larger federal complements might be the universities--their faculties and their new graduates, consulting engineering firms and major industries, or the state and local governments. It seems likely, on the basis of past performance, that the last will be the principal source. Thus, unless the states look carefully at all aspects of the employment conditions and practices they surround their technical people with, the expansion of the federal role and staff could have a snowballing effect in debilitating the capacities of the states to represent their interests and to do their jobs.

A final area of stock-taking that may well be indicated in a good many states is that which relates to effectuating programs and securing compliance with standards and requirements involving action by all the principal users and potential polluters of water. The term compliance seems preferable to enforcement; it is a broader term and embraces a wider array of instruments and techniques for achieving public ends. It includes informational and educational techniques, and surely there is not yet adequate official or public awareness of the gravity and ramifications of the problems of water resources. It extends to a variety of potential inducements including subsidies both direct and indirect, loans, and technical assistance. Finally, it embraces formal enforcement measures, applied through administrative proceedings or court action. Enforcement seems to be a tender subject in federal-state relations, and I do not find this surprising when I contrast the relative exposure of state people to pressures and the hazards that go with them with that of people in the federal establishment. It nevertheless seems possible that there have been occasions when the states have been ill-equipped or even loathe to take the more drastic course that the word enforcement implies. And perhaps drastic action is less likely to be needed if other compliance techniques have been exploited; perhaps, too, such action is less likely to be considered drastic if a fairly broad official and public understanding of the occasion for it has been achieved.

I am sure that I do not know enough about water pollution or water resource problems in the 50 states to say that each state needs to engage in self-examination along the lines that I have indicated. I think I know enough to believe that each state should ask itself the question whether such stock-taking is needed. The question might in summary be asked as follows: Should the state of ________ undertake the following self-examination?

1. Review the nature and extent of water pollution and water resource problems within the state, accomplishments of the recent past in dealing with these problems, and plans and programs for future activities. This review would be for the purpose of presenting the context within which official efforts have been made and should in the future be carried on.

2. Analyze statutes and regulations of the state as they control or affect program content, objectives, methods, and powers of administrative agencies concerned with water pollution control and water resource planning and use. This analysis would have the purposes of determining the legal framework within which the state's programs are being conducted, and of appraising the adequacy of this legal basis in relation to special problems presented within the state and to the experience and findings of other official and quasi-official bodies that have been concerned with the legal foundations of water pollution and water resource programs.

3. Examine recent trends in and the present situation respecting federal, state, and local financial support for water resources planning and management within the state. Such an examination would serve the purpose of providing a measure of comparative effort by the several levels of government and of tendencies therein.

4. Examine state and local personnel policies and practices as they relate to water resource administration, and inventory and characterize state personnel resources for such activities. The principal administrative resources of state government for water pollution control are represented by the number and technical qualifications of program personnel.

5. Examine (a) the structure of the state government in relation to and the internal administrative organization of agencies involved with water resources and water pollution control, (b) relationships among the interested administrative agencies, and (c) executive and legislative relationships as they affect the content, resources, and administration of these programs. These inquiries would seek to determine the setting within which program policy is fixed, financial resources are allocated, and available resources are employed in prosecuting the program.

6. Review administrative practices in state water resources management and pollution control, with specific attention to (a) information needed in and available for program planning and practices in obtaining and utilizing such information, (b) procedures and practices in formulating program policies, regulations, and interpretations, (c) procedures in license and permit activities, (d) geographical and related patterns in the utilization of staff, (e) formal and informal compliance and enforcement procedures, and (f) informational activities in support of compliance efforts. These appear to be the critical areas of administrative practice, and this review would seek to assess their suitability to the characteristics of the state and to the accomplishment of program objectives.

7. Review federal, state, and local program and administrative relationships within the state. Because these programs require action at all three levels, attention must be directed towards the effectiveness with which efforts are meshed into a unified and smoothly functioning program.

8. Analyze the relationships of state compact groups and regional bodies to action at the state level and the general effectiveness of such bodies, insofar as they may be represented within the state.

9. Review, through contacts with selected industrial establishments and industry groups, attitudes towards and responses to water resource and pollution control programs and activities.

THE CONUNDRUM OF CRITERIA

by

Robert K. Horton*

Mr. Chairman, members of the Association and guests:

The establishment of a joint committee on criteria signifies--in itself--attainment of a milepost. All of us are acutely aware of the confusion and controversy that enshrouds the problem of communicating information on pollution control--a problem that exists not only among engineers and administrators, but more importantly, a problem involving the relationship of pollution-control officials to laymen and to lawmakers.

Some of the sources of confusion and controversy are of a technical nature. Transcending technical considerations, however, are conflicts and contradictions in philosophy of approach to the conduct of pollution-control affairs.

It is not easy to enunciate the problem in specific language. And so, for the moment, may I label the problem simply as "The Conundrum of Criteria."

The difficulty in enunciating the problem came into sharp focus just a few days ago, when I was asked to write the charge to the Joint Committee on Criteria. I believe we all know--in a general way--what the committee is supposed to do. But translating general ideas into specific words is not an easy task.

I have written my version of the committee's charge. But before presenting this, it must be made clear that the committee, as a group, is not to be held responsible at this time for the charge as I have written it. Neither do I know that the charge as I have written it is acceptable to the three agencies that created the joint committee.

It must also be made clear that the material I am about to present reflects, at this time, only my own views on some of the subject matter facing the committee. For reasons of geography and time, there has been no opportunity for the committee as a whole to weigh this material and to express its collective views.

As committee chairman, I have considered my immediate task to be one of formulating a "working document," which, hopefully, might serve as a starting point for committee deliberations.

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* Chairman, Joint Committee on Criteria and Acting Director, Ohio River Valley Water Sanitation Commission

With this understanding, let me delineate what I believe to be some of the questions that must be resolved by the committee.

Charge to committee

The place to start, perhaps, is with the charge to the committee. My understanding of the charge is as follows: To recommend criteria or standards for use in measuring water pollution and progress, or lack of progress, in abating pollution, such criteria or standards to be: (1) based on information now available or readily obtainable; (2) expressed in terms that will be understood by laymen and professionals alike; and (3) expressed in such terms as will have fairly universal acceptance.

In contemplating this charge, I have had in mind one other bit of counsel given to the committee by one of the establishing agencies. The counsel is this: "Practically everyone agrees that ultimately we should come to the characteristics of the receiving water as our measure of pollution or our measure of progress."

In view of this counsel, it is the committee's duty to examine the possibilities and appropriateness of using stream characteristics as a yardstick.

Without belaboring the complexities involved, steps toward the use of stream characteristics might be outlined in broad terms. At some point along the way, of course, each stretch of water would have to be classified or categorized as to its use; that is, a decision would have to be made as to whether the water is to be maintained of such quality as will be suitable for recreational usage, maintenance of fish and aquatic life, potable supply, and so on.

There are many complications. For example, some "uses" might have application in one state and not in another. Consider, for example, the problem of acid mine-drainage. In some states, acid drainage is, and no doubt must be, a recognized "use."

Another important consideration in designating water uses is the element of time. Shall classifications be based on existing uses or uses that are anticipated or planned for the future? And if for the future, how far into the future?

Once the question of delineating water uses is resolved, the next step, perhaps, towards employment of stream characteristics would be establishment of numerical limits for each of the water-quality parameters that may affect a particular use (pH, DO, etc.).

It is impossible, at this time, to even guess at the number of parameters that might be involved. Public Health Service Drinking

Water Standards refer to more than twenty quality parameters. Presumably, consideration would have to be given to all of these, and a limiting value or range--to be applied in the stream--established for each.

Questions regarding stream-quality criteria

The prospect of establishing such limits or ranges leads to a series of questions. Which of the drinking-water criteria has application to the half-dozen or so other water uses? And what shall be the numerical values for these other uses? How many additional quality parameters will be needed? And what about background counts, which are needed not only for radioactive materials, but for other substances as well if pollution-subject-to-control is to be defined and measured in the stream.

The questions mount, and the problem begins to appear in its truly-formidable proportions. In short, the problem may be stated this way: How much research, how many dollars and what length of time will be required to develop the necessary answers? And will the answers, once developed, be obsolete by the time they have gained universal acceptance?

The magnitude of these questions highlights a dilemma that faces the committee--a dilemma that might well be a matter of first priority in the committee's deliberations.

The dilemma is this: If it is agreed (and I am not sure that it is) that "ultimately" we must come to the use of stream characteristics, should we--or rather, should the establishing agencies--make whatever arbitrary judgments are needed to permit immediate use of stream characteristics, or should we adopt some other system of appraisal as an interim measure until such time as gaps in knowledge can be filled in by research?

It may be argued, on the one hand, that initiation of an alternate system of measurement might blunt the drive to obtain necessary information and result in delaying the time when stream characteristics can be successfully employed.

On the other hand, it may be argued that the setting of stream-quality criteria in arbitrary fashion will be a worse disservice. Once quality criteria are established--by whatever method--they acquire an aura of authenticity, with the result that it becomes a Herculean task to get them changed.

Another disadvantage of proceeding immediately to the use of stream-quality criteria might be mentioned at this point; this stems from a point of view that actually has been demonstrated in practice. Suppose there is a sound basis for a certain numerical value of some constituent that would meet quality requirements for designated uses. And suppose also there are some areas in which concentrations of this constituent are far below that certain value. The argument will be made that acceptance of the numerical value as a stream criterion will lead to deterioration of water quality. And the question will be asked: Why should not the line be held, and the policy pursued of keeping concentrations at their existing low levels?

Alternate approaches

The committee, of course, has the job of weighing the merits of alternate approaches. As the chairman of this Association has said, there are about as many approaches as there are people speaking or writing on the subject.

Although it would be premature to go into any great detail on alternate approaches, it seems appropriate that consideration be given, at least, to one other approach at this time. For purposes of this discussion, I have selected an approach that--at first glance--appears to be about as far removed from stream characteristics as we can get. Instead of looking at stream characteristics, let us look at waste discharges.

For fear that some may interpret this as a step down the path of debating effluent standards versus stream standards, let me reassure them I have no intention of rehashing that age-old hassle. The argument, any way, often amounts to little more than a battle with semantics.

I am proceeding on the assumption that stream standards and effluent standards, although not synonymous, have a very intimate relationship. This assumption is based on the understanding that effluent standards are nothing more nor less than a fixing of responsibility by some regulatory agency of what has to be done to obtain certain quality conditions in the receiving stream.

Viewed in this light, an approach to the "conundrum of criteria" using waste discharge data, and an approach using stream characteristics are not 180 degrees out of phase; in fact, the two are tied very closely together.

First things first

The use of waste-discharge data may offer some advantages, the most important of which might be an opportunity to put "first things first."

In examining possibilities of a system of criteria based on waste-discharge data, we come immediately to the categories of municipal wastes and industrial wastes.

The problem of municipal wastes does not seem too difficult. What we are really concerned with, it seems, is the amount of waste that is discharged in compliance with regulatory requirements and the amount that is discharged not in compliance. All sewered communities are--or should be, it seems safe to assume--under compulsion to comply with some waste-control requirement.

Variations in control requirements are inevitable, of course, because of differences in amount of stream flow, size of load, and all the other factors so well recognized.

One factor that deserves special mention, however, is again, water usage. Waste-control requirements reflect decisions regarding intended uses of the receiving stream, whether these decisions are explicit or implied.

Another consideration to be recognized is that in the field of water-pollution control there are overlapping jurisdictions--a situation certainly not uncommon in matters concerned with police powers. This means that waste-control regulations may include those promulgated by local, state, interstate or federal authorities, which authorities may act individually or collectively.

The essential fact is that waste-control regulations now exist, or will be established, for all controllable sources of pollution. What we need to know is: To what degree are these regulations being met?

The terminology to be used in answering this question is at the very heart of the committee's assignment. An obvious yardstick of measurement is amount of population served--or not served--by treatment facilities meeting established control regulations. It might be that no other single parameter comes as close as an indicator of the municipal pollution load. If this is true, then application of this parameter would be a step toward putting "first things first," and it would provide a base on which refinements subsequently could be imposed.

The committee, I know, has many ideas regarding more sophisticated parameters. These, of course, will be developed as the work of the committee progresses.

Industrial wastes

Turning now to the problem of industrial wastes, let me say, first, I share with you the sentiment: "There's the rub."

But here again, I believe opportunities are available for putting "first things first."

The first order of business might be establishment of criteria regarding the visible effects of industrial wastes. If we accept the philosophy that insofar as appearance is concerned, streams draining industrialized areas should be as good in quality as streams draining other areas, then perhaps agreement can be reached on a "first step" in the control of industrial wastes.

The first step might envision adoption of some fundamental, or minimum, requirements that could be applied to all industrial plants. These requirements would be directed toward control of obvious pollution; that is, pollution that is offensive to sight and smell. The requirements might provide, for example, for treatment of industrial wastes so as to maintain receiving streams free from sludge deposits, free from debris, oil or other floating materials, and free from substances producing color or odor nuisances.

If requirements of such a nature--simple and fundamental-- could be applied universally, then at least, a point would be reached where we could talk about the number of industrial plants that has eliminated obvious pollution and the number that has not.

Once this point is reached, refinements in pollution-abatement criteria for industrial wastes could be undertaken.

As in the case of municipalities, each industrial plant is under compulsion to meet certain regulations. These regulations do and must go beyond simple, "first-step" requirements in virtually all cases.

An inventory showing number of industrial plants meeting established control regulations, including "first-step" as well as additional requirements, and number of plants not meeting such regulations would provide another common meeting ground.

To leave the question of criteria for industrial-wastes merely in terms of "number of industrial plants," however, would fall short of the goal that has been set for the joint committee. Some method is needed for equating--or rather differentiating--industrial pollution loads.

The parameter used so often for comparing industrial loads to municipal discharges is "population equivalent." The shortcomings of this parameter as a universal index need no elaboration here. If the parameter could be applied universally, there would be no reason for establishment of the Joint Committee. For example, one of the questions facing you as administrators is: How is "population equivalent" to be determined for wastes containing such materials as fluorides, radionuclides, chlorides and cyanides?

Ingenious ways have been suggested over the years for assessing the relative effects of different kinds of industrial wastes. One proposal (by the late Charles Agar of New York), which dates back to 1949, suggests that the pollution load from an industrial plant--and the plant's share of assimilative capacity of the receiving stream--be apportioned by a formula using such factors as volume of waste, number of employees, assessed valuation and pounds of material discharged. This proposal and others of similar nature merit the attention of the committee.

Comparability of state programs

There is one final question I wish to mention. This relates to the problem of comparing the pollution-abatement program of one state with that of another.

Because of differences in use classification, one state may have very stringent regulations and another relatively lax regulations.

It has been suggested that dollars be used as the common denominator. If dollars are used, then to compare progress in one state with that in another, information will have to be assembled on the total investment (including operating costs) required for completion of a state's pollution-control program, and the amount of this investment that has been made at any particular time.

To cite an example of one complication in using dollars, the matter of "good housekeeping" might be mentioned. It is well known that "good-housekeeping" practices by industry have resulted in the reduction of pollution loads. But how is a dollar value to be placed on this effort and its accomplishments?

Conclusion

In conclusion, this statement is an effort to set forth some of the questions facing the Joint Committee. The questions are, perhaps, best summarized in the charge to the committee, which says, in effect, the establishing agencies are looking for a system of terminology that will allow clear communication regarding progress that is being made in controlling water pollution.

The problems center around conflicting philosophies and differing opinions on such matters as the amount of time, effort and money to be spent in developing information that is needed for application of whatever system of terminology is selected.

Some alternate courses of action have been outlined. But as was said at the beginning, there are about as many approaches to the problem as there are people.

The committee is anxious to have suggestions, comments and ideas from the association, from the other establishing agencies and from all who are concerned with the problem.

I assure you of conscientious effort on the part of the committee. We look forward to your help and guidance. With your counsel, we can confront the convolutions of conflict, contradictions, controversy and confusion, and resolve the conundrum of criteria with confidence and conviction.

FINDINGS OF THE ADVISORY COMMISSION ON INTERGOVERNMENTAL RELATIONS ON URBAN WATER AND SEWER PROBLEMS AND THEIR IMPACT ON STATE WATER POLLUTION CONTROL ADMINISTRATORS

by

Norman Beckman*

From its very inception government has been concerned with the development and regulation of water. Indeed, a history of intergovernmental relations generally could be written by describing governmental water resource activities in the United States--replete with both scandals and successes. At no point in the structure of the American Federal system of government are problems of intergovernmental relations with respect to water supply and sewage disposal so marked, varied, and difficult as in the large metropolitan area. Within such areas, which now contain the great bulk of our population and productive resources, must operate Federal agencies providing financial assistance and regulation, State agencies concerned with allocation and control of local activities, and county and municipal agencies, supplemented by a host of special units of local government administering water supply and waste disposal systems. All these government agencies must carry on their water functions in close juxtaposition.

In doing so they are subject to an extremely complicated framework of Federal, State and local laws. Further, these governments must mediate the claims of various interest groups--of urban, suburban, industrial, navigation, agricultural, flood control, conservation and recreation--in the administration of this increasingly scarce resource. A further complication is the interjurisdictional, interstate, interregional and, indeed, international competition with respect to the allocation, use and regulation of American water resources.

One of the first problems that the Advisory Commission on Intergovernmental Relations turned to, therefore, was a study of what could be done to achieve satisfactory water supply and sewage disposal services in these areas. I would like to (1) identify the main findings of the Commission study, (2) describe the recommendations for action proposed by the Commission based on these findings, and (3) report the status of actions to date in achieving implementation of these recommendations. For those interested in the full Commission report, Intergovernmental Responsibilities for Water Supply and Sewage Disposal in Metropolitan Areas, or the model legislation described below, copies are available upon request from the Commission's offices at Washington, D. C. 20575.

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Since my agency, the Advisory Commission on Intergovernmental Relations, is fairly new on the governmental scene, I might briefly describe its organization and purpose. The Commission is a continuing national body created by Congress in 1959 and charged with studying problems of Federal-State-local relations and with making recommendations to Federal, State and local governments for improving the effectiveness of our federal system of government. The Commission is a bipartisan body comprised of 26 members; three come from the general public, 14 from State and local governments, six Congressional representatives and three members of the Executive Branch.

Findings

The study revealed that there is considerable opportunity for improvement in the manner in which all three levels of government carry out water programs affecting metropolitan areas. Among the major findings with respect to current governmental practices in providing water and sewer services in metropolitan areas were these:

Public investment is inadequate in both water and sewer facilities, but sewage treatment and water quality are more pressing problems than are water supply and distribution.

Water problems are most critical in the suburbs. A large part of the difficulty arises from reliance on individual water supply and waste disposal systems which rarely provide a permanent solution to the problem of obtaining and disposing of water.

Areawide approaches to the provision of water utility service and sewage service facilities offer economies of scale, protection against unwise investment, equalization of rates, and adequate base for long-range developmental programs with capacity for growth. These goals can often be reached through reform of the contract system or through use of subregional or cooperative approaches consistent with overall development plans as well as by establishment of operating water agencies with a regionwide jurisdiction.

Where the central city or county serves as contractor, it should assume responsibility for comprehensive areawide facility planning, encourage the most economical development of service lines to the contracting areas and ease the supplier-purchaser relationship through suburban representation on water-sewer agencies.

It also became plain that comprehensive water utility planning should be undertaken on a metropolitan area as well as watershed and drainage basin basis. Such plans should relate water and sewer proposals to other planned urban development activities.

The role of State government in urban water resource development and the abatement of pollution may be expected to grow in importance. Potentially, the most important areas of State activity are comprehensive planning and actual development (now limited to New Jersey and California) of urban water sources. The prime weakness of State public health regulation and water pollution control is the failure to enforce existing water quality regulations and undue reliance on cooperation.

State programs designed to facilitate the provision of local water and sewer service abound. Most successful are technical assistance and training programs together with cooperative research and planning efforts. State financial assistance is quite meager considering the national investment requirements for water and sewer utilities.

Federal grants for sewage treatment construction have provided a significant incentive for increased investment at the local level and have spurred rather than stifled State and local initiative. Federal water quality control research and enforcement efforts are important to the continued effectiveness of State and local abatement programs. However, the Federal grant and loan programs do not provide adequate incentives for more economical and comprehensive sewage treatment facilities in metropolitan areas. Nor have these programs had a significant effect on the problems of industrial pollution.

The two ultimate custodians of governmental power under our system of government are the States and the Federal Government. The Commission, in its work, is not satisfied to simply make recommendations. It recognized that major changes in Federal and State programs are necessary to meet the problems of inadequate investment, uneconomical water utility development, fragmented responsibility, individual water and waste disposal systems and industrial pollution control.

Recommendations for State Action

State Water Resources Coordination

Traditionally, water pollution control, water allocation, water resource development, and other phases of the overall water resource problem have been administered independently by different agencies and independent boards within the State governments, thus providing inadequate attention to long range planning and policy coordination. Now, with the rapidly expanding and often competing needs of agriculture, industry, recreation, and urban areas for more clean water, there is an urgent need to assure that these demands are met in a coordinated way. It appears neither wise nor necessary to concentrate all operating responsibilities in a single agency, particularly the technical activities undertaken by the health agencies.

The first recommendation the Commission makes to the States, therefore, is that they enact legislation vesting responsibility for overall State water resource planning, policymaking and program coordination, but not necessarily operations, in a single agency responsible to the Governor. A model bill to carry out this recommendation has been prepared by the Commission and distributed to the States. This bill has been endorsed by the Council of State Governments, the National Legislative Conference, the National Association of Counties, and the American Municipal Association.

More Vigorous Enforcement

Enforcement is a crucial aspect of water pollution control by the States. Most States rely on a cooperative approach in attaining compliance with State water quality standards. Cooperation is undeniably the preferable and generally successful method of securing compliance. Cooperation, however, must not be an excuse for inaction and inadequate enforcement of State water quality regulations.

In most cases the States have adequate authority to control and abate pollution of rivers and streams, singly and in cooperation with other States. This authority should be accompanied by adequate financial support. The greatest need, however, is not the availability of sufficient authority, but more enforcement. A recent staff report to the Senate Committee on Public Works indicated that where States have been aggressive in the use of enforcement proceedings, they have been very successful. However, the report concluded that State enforcement activity has not received the vigorous emphasis necessary and required by the extent of water pollution problems. Thus, of some 42 States surveyed, 17 States have never brought court action, 15 States have brought less than five and only three States have each brought more than 15. Financial support of State programs is likewise most uneven with five States accounting for 50 percent of all State funds for water pollution control programs.

The States should enforce water pollution legislation and regulations affecting public health and recreation, municipal, industrial and other uses with greater vigor and thoroughness. To insure that cooperative techniques in enforcement of water pollution control programs do not become facades for delay and inaction, time limits should be provided for each step in the pollution abatement enforcement procedures.

State Financial and Technical Assistance

Public investment in water and sewer facilities is inadequate. The most fruitful approaches to the problem of inadequate investment are the provision of incentives in the form of matching grants, State review and guidance with respect to development of water resources and urban water supplies, more rigorous enforcement of public health and pollution control requirements and improved service areas offering economies of scale.

Compared with investment requirements and with Federal aid, State financial assistance overall has been modest. Moreover, less than one-fifth of the States provide direct financial assistance.

Specifically, the States should (a) provide financial aid to supplement Federal aid for the construction of sewage treatment works, (b) undertake a more active role with respect to water source development and water supply availability, including taking full advantage of authority to contract for anticipated future water supply requirements in Federal water storage projects, and (c) provide incentives for water and sewer activities to be planned and carried out on comprehensive watershed, drainage basin or metropolitan area bases. The States should play a positive role in assuring that localities have available the means to finance required sewerage systems. State operations and aid should include the use of State fiscal ability and credit, relaxation of State restrictions on local borrowing ability, expanded technical, consultative and engineering services, and supporting research and information activities.

Control over Individual Wells and Septic Tanks

The indiscriminate use of wells and septic tanks encourages urban sprawl, often endangers public health, and rarely provides a permanent solution to the problem of obtaining and disposing of water. The only real answer for suburban areas is community or public systems of water supply and waste disposal properly coordinated with other land use development. A survey made by the U. S. Public Health Service in January 1963 showed that, although every State has broad authority to regulate local sanitary practices, no State has legislation specifically establishing policies which would limit the use of individual water supply and sewage disposal facilities in suburban areas.

Model legislation has now been prepared by the Advisory Commission in cooperation with the Public Health Service which would give the State Department of Health the authority to establish such regulations to limit control or prohibit the use of individual wells and septic tanks in urban areas and to require provision of community water supply and sewerage systems. The proposed legislation would require urban jurisdictions to prepare, adopt and submit to State health departments for approval, their comprehensive plans for water and sewerage facilities. In soon-to-be-developed areas provision is to be made in original housing construction for connecting to community systems in as economical and as convenient a way as possible as soon as they are available. Interim community systems are to be preferred over installation of septic tanks and wells. The Association of State Health Officers recently endorsed the principles of the model law emphasizing that every State ought to have such a law and just last month the Surgeon General of the Public Health Service instructed the Service's regional offices to make special efforts to give technical assistance and consultation to States and municipalities who wish help on this problem.

Recommendations for Federal Action

Amending the Water Pollution Control Act

The Federal Sewage Treatment Construction Grant program administered under the Water Pollution Control Act has contributed to much of the progress that has been made in overcoming the lag in sewage treatment investment. These Federal grants, however, could also be used as a more effective tool for shaping a better urban community. The Federal aid program, at present, provides no incentives for economic and comprehensive waste disposal projects in metropolitan areas. Likewise, the Commission found that the full potential of this grant program is not being realized in the case of our larger cities. Because of statutory ceilings in individual grants Federal aid totals less than 10 percent of the costs involved in sewage treatment projects for the larger cities.

The record of the construction grant program since its inception in 1956 indicates that while communities of 125,000 and over represent 46 percent of the total population aided by this program, they received only 9 percent of the grant funds made by the Federal Government to communities ($25.5 million out of a total Federal expenditure of $290 million).

The Commission is, therefore, recommending Federal legislation which would (a) authorize an additional 10 percent to be made for those projects that are certified by an official metropolitan planning agency as being in conformity with a comprehensive plan of development; and (b) raise single project grant ceilings from $600,000 to $1,000,000 and joint project combined grants from $2,400,000 to $4,000,000. An omnibus bill containing these provisions, among others, amending the Water Pollution Control Act has been passed by the Senate and will be shortly considered by the House Public Works Committee.

Amending The National Housing Act

The present 50,000 population limitation for eligibility under the Facilities Loan program, administered by the Housing and Home Finance Agency, has several major disadvantages with respect to meeting governmental responsibilities for water supply and sewage disposal in metropolitan areas. First, it directly discriminates against communities of 50,000 population or more by not permitting them to receive public facility loans. Second, it encourages fragmentation, duplication, and inadequate long-term facilities by prohibiting bond action by a number of communities within a metropolitan area acting together to meet water and sewer needs. We have proposed that the Public Facilities Loan Program be amended to permit communities of 50,000 or more, singly or jointly to qualify for sewer and water project loans.

Growing communities are faced with a special problem in the provision of public facilities. While it may be clearly apparent that there will be rapid population growth in the years just ahead, present tax resources and financial capacity make it difficult or impossible for them to provide now for the needs of the immediate future, however economically feasible in the long term such action would be. It is therefore proposed that the Public Facility Loans Program be further amended to effectively permit deferral of interest payments for projects planned to meet future growth needs.

Finally, the Commission has proposed that the National Housing Act be amended to provide that individual or subdivision development projects utilizing individual wells and septic tanks be ineligible for the FHA insurance in areas where the installation of public or community water and sewage systems is economically feasible. It has also proposed that Congress provide FHA insurance for development of public or community water and sewerage systems. This would make it possible for smaller builders and developers to undertake land development activities on a more competitive basis with those larger developers who are more readily able to do so, and would go far toward reducing the future uneconomical and unsatisfactory investment in septic tanks and wells in our growing urban areas. Proposed Federal legislation amending the National Housing Act to carry out these recommendations has received the endorsement of such groups as the American Municipal Association, U.S. Conference of Mayors, and the National Association of Counties.

The Industrial Pollution Problem

Finally, the Commission found that current Federal grants for sewage treatment construction and Federal endorsement efforts have not had a sufficient effect on the problems of industrial pollution. It was concluded that Federal action is needed through the use of strict enforcement power or financial incentives, or both, for pollution abatement. The Commission, therefore, recommended to the President that study be undertaken within the Executive Branch to develop an appropriate Federal program, and the roles of State and local governments in such a program. Favorable Executive Branch response led to the signing of a contract in June of this year by the Public Health Service with the Institute of Public Administration to evaluate possible measures for bringing about industrial pollution abatement.

Conclusion

The primary problems of water supply and pollution control in our metropolitan areas are governmental rather than technical and these governmental problems can be effectively attacked through cooperation and action of all three levels of government. Comprehensive planning and policy coordination on a regional basis hold the most promise for metropolitan areas in dealing with their water problems. If one may venture a prediction, the role of the States will continue to grow, particularly in allocation of water to urban areas, development of urban water supply resources and financing of sewage treatment facilities.

New directions at the Federal level will include perhaps increased Federal involvement in the control of pollution in interstate waters, especially industrial pollution, and a greater recognition of urban water needs in the administration of the many Federal water resource programs.

BOATS AND MARINAS AND THEIR IMPACT ON WATER POLLUTION CONTROL

by

Thomas F. Kelleher*

I am very pleased to be here at the invitation of your Executive Secretary, Mr. Paessler, to participate in your conference. I am especially grateful for your interest in the problem of water pollution from boats and marinas. I feel that much good comes from meeting with groups such as this. It enables us to scrutinize more closely our day-to-day problems, and it provides the invaluable benefit of person-to-person meeting and exchange of ideas, something we all need from time to time.

Over the past months I have attended eight large boat shows in different sections of the country, meeting with State and city health officials, various groups representing boat manufacturers, and advisory councils and associations connected with the boat and marina industries. I would like to report my findings.

We must recognize that boating is today the most important recreation from the dollar volume expended in the United States. Americans spend more money on boating than on baseball, fishing, golf, or any other single recreation. Wherever they live, people show a strong urge for water-oriented recreation. The growth of the boat and marina industry in the last ten years has been phenomenal. Best estimates indicate that there are more than 8 1/2 million pleasure boats and 5,200 marinas presently in operation. The industry did a two and a half billion dollar business in the United States during 1962. In the face of this, America afloat is still clamoring for additional waterfront facilities. Demands for boat housing and better facilities are unprecedented. There is apparent need for twice as many boat slips and docking facilities as now exist, and boat owners seem ready and willing to pay for the increased services. Imagine what the boating pressure will be with a 50% increase in population and a similar increase in leisure time!

In my contacts during the past year, I sought and gathered information on the present issues of planning for boat and marina sanitation. Most of the people I talked with recognize that sanitation is a prime factor in boating enjoyment, and its control is a must if all are going to continue to enjoy the waterways.

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The time appears to be ripe for insisting upon the installation of appropriate boat pollution control methods. This is recognized by the regulatory agencies, and during 1962 and 1963 there has been a virtual wave of State legislation to stimulate more. In fact, from the interest shown by the many agencies at State, local, and Federal level and from the boating industry itself, one might say this is the most popular cause that has come in our direction in many years. There does need to be better communication and a better system for coordinating and transmitting valuable ideas among the interested groups.

My contacts also recognize that the problem varies from State to State. However, even within this rather large variation of conditions there are undoubtedly many elements of common interest to all parties. If we are unable to agree upon near uniform regulations covering pleasure craft and marinas, there will be a great deal of confusion for the boating industry and for the individual who inevitably will traverse the waterways from State to State in much the same way he now uses his automobile.

Compared with the magnitude of sewage waste from communities and industries, it might be conceded that the sewage discharged from pleasure craft and marinas is of relatively small dimension. I believe, however, that the potential for boat pollution is sufficient to command the attention of regulatory agencies, developers and designers, and equipment manufacturers, and boat owners. Certainly as recreational areas wedge closer and closer together these problems will demand increased attention.

I am pleased to report to you that boating groups such as the American Boat and Yacht Council and the Yacht Safety Bureau already recognize a need to consider the sanitary disposal of wastes originating aboard water craft, and that their recognition of these needs is being incorporated in the design, manufacture, safety, and servicing of pleasure boats and boating facilities. I believe that credit for enlisting the American Boat and Yacht Council in this laudable activity goes to the New England Interstate Water Pollution Control Commission. The Commission initiated and sponsored conferences with the boat industry beginning in 1955.

It was at the request of one of its signatory States, New Hampshire, that the New England Commission asked for assistance in developing a sewage treatment device for small pleasure craft. Within a year the American Boat and Yacht Council presented to the New England Commissioners a treatment device suitable for small boats. In 1957 the State of New Hampshire adopted regulations for controlling water pollution from marine toilet effluents. This law, incidentally, was the first of its kind in the United States.

Anticipating that other states would be contemplating legislation with regard to boat pollution, the Council of State Governments drafted a suggested "Model Law" in 1958. This is based in large measure on the New Hampshire law.

At succeeding meetings called by the New England Commissioners progress was made in developing tentative standards and in improvement of equipment to meet these standards. The improvements included a macerator for sewage solids to promote thorough disinfection. Four different miniature sewage treatment units are now available for installation on small boats, as are two new holding tank devices which provide facilities for disposal at the marina.

Equally important to future prospects for control of boat pollution are the steps that have been taken by the American Boat and Yacht Council to acquaint boat designers and manufacturers with needs and how they can be met. For example, in the standards adopted by the Council, it is recommended that space of at least 24 x 14 x 17 inches be allotted on all new boats of the cruiser type to accommodate installation of sewage treatment devices.

Further evidence that the boating fraternity is alive to the problem and its obligations for proper sewage disposal comes from the Outboard Boating Club of America. They have made great efforts since 1959 in circulating the model act to acquaint State legislators and others with the nature, scope, and draftsmanship of appropriate regulations. Now the Outboard Boating Club of America is campaigning among boat manufacturers, urging that provision be made on all new water craft for the installation of sewage-treatment facilities, and also suggesting a campaign to be carried out by every boating club in the interest of clean water.

Not the least of the burdens that face State agencies with regard to boat pollution control relates to the establishment of an effective inspection system. The futility of legislation that is not conscientiously enforced is stressed by representatives of the Outboard Boating Club of America and the American Boat and Yacht Council. Quite possibly pollution control boards may find it useful to enlist the aid of their State agency charged with boat licensing. Starting last year a number of States (45) undertook this licensing function which heretofore was a Federal function under Coast Guard jurisdiction.

I should like to draw my discussion to a close by briefly outlining to you the conclusions we have reached regarding the problems connected with the administration of water quality control programs involving pleasure boats and marinas.

1. There is need for a clearing house on ideas, legislative proposals, and research findings so that they can be disseminated promptly and regularly to appropriate people.

2. There is a need for a well-considered research program on marine waste disposal techniques and minimum requirements.

3. State and local laws must be sufficiently uniform to permit boat owners and operators to pass from State to State without being challenged on waste treatment equipment aboard.

4. A system of State regulated inspection is required to insure that boats are properly equipped for waste treatment and that it is in operable condition; and to help educate the boating public on the necessity to follow the rules.

5. Regulatory agencies and marina and boat designers should be in close communication for planning and developing facilities which are properly located, dependable, practical and adequate.

6. We need a good slogan to promote water cleanliness by boat operators and, finally,

7. Now is the time for the administrators to act positively and strongly.

It has been a great pleasure and honor to have been invited here to speak to you gentlemen who give of yourselves in talent and devotion to duty in your community, State and regional movements for clean water. In behalf of the U. S. Public Health Service, I thank you.

MARINE TOILET CHLORINATORS FOR BOATS

by

Russell A. Eckloff*

In 1954, under the aegis of the late Seth G. Hess, Director of the Interstate Sanitation Commission, a treatment device for marine boat toilets was developed and tested. This device provided for maceration and chlorination of the wastes before discharge.

In 1955, Wilcox-Crittenden developed a simple unit which provided for chlorination after the solids were broken up to a degree by a joker valve. All concerned with the development of this unit were confident that this unit would prove to be acceptable as tests by a laboratory were reported to show satisfactory disinfection of the wastes.

On the basis of these tests, and assurance that an adequate treatment device was available, the New Hampshire legislature enacted a "Marine Toilet Law." Early in 1958, the New Hampshire Water Pollution Commission adopted and issued in toto the recommended practices and standards prepared by the American Boat and Yacht Council. Aside from the materials of construction and other details, the most important requirements for the purposes of this paper are:

(1) the effluent shall be free of unsightly floating solids
(2) the effluent shall contain an MPN of coliform bacteria not exceeding 240 per 100 ml
(3) the treatment device shall function automatically with the operation of the marine toilet

In 1959, a new chlorinator by Raritan Engineering Company was submitted to us for test. This unit contained an electric motor-driven macerator. To evaluate this unit so as to permit its use on New Hampshire waters, laboratory comparison tests were made of both the Wilcox-Crittenden and the Raritan. It was found that neither unit met the requirements of the Commission. Subsequent development of the Raritan unit allowed it to meet all requirements except it was not automatic. However, the Wilcox-Crittenden unit, while automatic in operation, failed to meet the unsightly solids and MPN requirements.

The New Hampshire Water Pollution Commission decided to authorize the use of both units so that some degree of health protection would be afforded the public. It was understood that when a unit was developed which met the three major requirements of the Commission, it would be approved and the authority granted for use of any other device would be cancelled.

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Accordingly, when a device from Carlson and Son was tested, their Mark 5 unit was approved and the authorization for use of Raritan and Wilcox-Crittenden was cancelled as of April 10, 1963. Use of the two latter makes, if already installed, will be permitted, but the installation of either device after April 10, 1963, is illegal.

With the advent of an approved device, developmental testing by New Hampshire was stopped. Close to twenty models from six manufacturers have been evaluated. From these evaluations certain conclusions were drawn and published in May 1961:

(1) Violent agitation of the head wastes to break up all fecal matter is essential
(2) the dose of disinfectant must be applied during or prior to agitation
(3) About 300 ml of 5.25% sodium hypochlorite was necessary for disinfection as measured by the MPN of coliform bacteria
(4) a fill-and-draw action in the treatment device would prevent short-circuiting which must occur in every flow-through device.

In ascertaining the efficiency of a treatment device the Most Probable Number of coliform organisms is first determined on the dechlorinated effluent. Then 500 ml of the dechlorinated effluent is subjected to 15 seconds agitation in the Waring Blendor with a speed in excess of 10,000 r.p.m. The MPN of the blended sample is then determined by the multiple tube technique. A significant increase in the MPN of the blended, over the unblended sample, simply means that maceration of the fecal matter was incomplete as the viable bacteria encased in the undispersed solids were released by the additional agitation in the Waring Blendor. Some of these same bacteria would have been released into a receiving water by action of propellers, wind or the natural breakup of the fecal particles. In this connection it should be stated that great care should be exercised in extrapolating the theory and practice of orthodox sewage treatment. For instance, we found no correlation between residual chlorine and the MPN of the effluent, even with ortho-tolidine residuals in the range of 100-400 p.p.m. Chlorine doses are extremely high, reaching the figure of 10,000 p.p.m. available chlorine in some units tested.

Again, the 15-minute detention time considered as standard in the sewage treatment field for adequate disinfection does not apply in the marine toilet field. It has been shown by us and confirmed by another investigation that disinfection by chlorine occurs rapidly. This, of course, explains why it is necessary in these devices to break up the solids immediately so as to expose the bacteria to the free chlorine before it can react with the organic matter or change to the less effective chloramine. All of this is not surprising to those who have been concerned with the mechanism of disinfection by chlorine, but it does depart from orthodox sewage treatment practice.

It has been suggested by some that the MPN of the effluent does not need to be lower than 1000 per 100 ml or lower than the MPN of the background or flushing water. Whether an MPN, not exceeding 240 or 1000 per 100 ml is chosen, is academic. To insure either, 100% of the time, a virtually complete kill of coliform bacteria is necessary. The increase in dosage of chlorine to reduce the MPN to less than 3 per 100 ml from either 240 or 1000 is negligible.

The other suggestion, that it is unnecessary to disinfect below the MPN of the background is considered unsound. The purpose of the treatment is both esthetic and for the protection of public health. For the latter purpose, anything less than complete disinfection as customarily measured may permit the discharge of viable pathogens into bathing waters or water used for harvesting shellfish. Further, to provide a treatment device where the dosage of disinfectant may be varied, depending upon the quality of the particular body of water being used, will certainly result in lack of disinfection where really needed. This question poses itself. How would a boat operator determine the MPN of the receiving water so he could adjust the hypochlorite dose?

The design of chlorinators varies as to method of disinfectant application. Obviously, ideally, the disinfectant dose should be proportioned to the requirement. It is equally obvious that the first few strokes of the marine toilet pump carries the bulk of the fecal matter to the treatment device. Where the feed method tends to produce a nearly constant rate of feed, an overdose of disinfectant must be used to insure that the initial chlorine requirement is met in any flow-through device. This is accomplished in one unit by a one-shot pump. With two other units, the disinfectant is fed either by eduction or by a small pump.

In the one fill-and-draw unit so far received, the disinfectant is fed by gravity with a solenoid valve for control.

Due to economic, electrical, and space considerations, all units so far received are equipped with motors whose speed varies with the density of the material being agitated. This in turn, varies the rate of flow of the disinfectant when eduction is employed. It follows that with all devices employing eduction as the pumping of the toilet progresses and more dilute liquid waste flows past the agitator blades, the motor speeds up and the disinfectant dose increases when a decrease would suffice. This again leads, of necessity, to a large increase in disinfectant use.

Two methods of providing that the toilet cannot be pumped without starting the macerator motor and the disinfectant feed are employed. One of these is a pressure switch and the other is a spring-loaded valve on the water inlet line to the toilet. In both cases, a timing mechanism controls the action of the device. To date, the spring-loaded solenoid valve is the more successful device.

As to the future, the presently successful device would seem to be too expensive for general use, but quantity production and competition will alleviate this problem. Second, it should be unnecessary for each state to set up its own standards and conduct its own evaluation of each unit.

There should be a nationwide standard for treatment devices and a single laboratory whose stamp of approval would be acceptable in all states. The more quickly these steps are taken, the better. It should be borne in mind, however, that what has been presented here deals only with the public health aspects. There are the safety features, which, from the marine underwriters point of view, must be subject to test by a recognized laboratory. In fact, electrical and mechanical tests may be found to be more difficult to meet than the relatively simple chemical and bacteriological tests necessary in evaluation of the unit.

Enforcement

In New Hampshire the registration of boats and outboard motors is carried out by the Department of Safety. The application for registration has two pertinent questions:

1. Is a marine toilet aboard the boat?
2. Does it conform to New Hampshire requirements?

The inspectors of the Department of Safety are in good position to assist in the enforcement of the marine toilet law and, in fact, have reported to the Water Pollution Commission the existence of marine toilets which were not declared on the application for registration of the boat.

The efforts of the Water Pollution Commission to date have largely been along educational lines, working through boat dealers and marine operators. These people have distributed copies of the law and regulations and have assisted boat owners in complying with the requirements. A crew of two water pollution technicians has made many inspections of boats equipped with marine toilets since the effective date of the law. The violations encountered fall into three categories:

1. There is no treatment device attached to the marine toilet.
2. An unauthorized device has been installed.
3. The hypochlorite reservoir was empty.

During the 1962 boating season, violations were less than 7.5% of the boats inspected. Incidentally, the vast majority of the boats are inspected as they come to boatyards or marinas. A patrol boat with the name of the Commission prominently painted thereon gives ample notice to all concerned that their boat may be inspected at any time for compliance with the law.

The problem of enforcement has by no means been completely solved. Up to the present time, we feel that the cooperation of boat owners has been excellent. They have exhibited a sincere desire to take the necessary measures to help maintain the high quality of our New Hampshire lakes.

However, boating is rapidly becoming a recreational pursuit of the masses, and as such, we can expect more and more enforcement problems. Sixteen and seventeen foot boats are now being equipped with toilets. These craft are easily transported many miles for a one or two week vacation period or even for a weekend. In New Hampshire, registrations may be obtained at many marinas and general stores. Applications are submitted weekly to the state office of the Department of Safety. One of our men goes through the new cards each week to obtain data relative to existence of marine toilets. It can readily be seen that many of these easily mobile craft enter the state and leave before we are aware of their presence. A few are encountered by chance at docking facilities or by the patrol boat. A few owners, when informed of the requirements, have, in a huff, hauled their boats out of the water and gone off to some other state. Incidentally, boats having a length of 24 feet or more and equipped with twin outboard motors are easily transported at the same speed as ordinary traffic and their owners may visit a different lake on each succeeding weekend. Just as credit purchasing has brought the automobile to most families, so also credit buying is permitting many families to display the new status symbol. It is not unusual to see a shiny new boat and trailer fastened to an automobile that in comparison looks like an old jalopy. Under these conditions, the family budget is strained and an attempt will be made to effect economies. Unfortunately, these penny-pinching practices are usually those which are related to health and safety.

There have already been complaints relative to the high cost of a treatment device and also of the high cost of hypochlorite - it requires about six cents worth of Clorox for each flushing of the marine toilet. It is not inconceivable that the 5.25% available chlorine solution may be diluted to such an extent as to be virtually 100% water in an attempt to reduce operating costs. Enforcement personnel must, therefore, be capable of sampling and determining the strength of the hypochlorite solution in the reservoir of the treatment device.

Ideally, to prevent pollution of surface waters 100% of the time from boats equipped with marine toilets, the discharge of wastes should be prohibited. The installation of a tank aboard the boat to hold the sewage for subsequent pumping to either a public or private sewerage system seems to offer promise for pollution control. However, let us not forget that even with this method, the integrity of the individual boat owner will determine its effectiveness. When a storage tank is full, and someone needs to use the head, a trip must be made to an approved disposal site or the contents pumped overboard. Under cover of fog or darkness, the latter case might be the rule rather than the exception unless adequate safeguards are provided to prohibit such disposal.

DETERGENTS AND OUR NATIONAL WATER POLLUTION PROBLEM

by

Theodore E. Brenner*

With the passage of Public Law 845 in 1948, the first National Water Pollution Control Act, a new era of interest, research and expansion in this vital field was initiated. By that time it had become apparent to Congress, as it had been to professional groups for some time, that new emphasis in protecting our national water resources was necessary. Since then a quiet revolution has been taking place with the passage of more comprehensive water pollution legislation at the local, state and federal level and with the expenditure of vast sums to control municipal and industrial pollution sources.

At the same time another quiet revolution has been taking place in the American industrial world.

What had been for many years the soap industry was rapidly becoming the soap and detergent industry and, perhaps even more accurately, the detergent industry. When synthetic detergents were introduced to the American market in quantity during the late 40's, they were considered largely specialty items which would find their principal application in hard water areas. These new synthetic detergents, or syndets, however, became so popular with the American housewife because of their superior cleaning characteristics under adverse conditions that their use soon far outpaced that of soap. So much so that today they constitute some 79 percent of the total soap and detergent production in the U.S.A.

In the early 1950's it became apparent that the paths of these two revolutions were to cross. A significant constituent of the packaged detergent -- the product you buy in the supermarket -- is alkyl benzene sulfonate or ABS, which is a petroleum base material which provides the surfactant or surface active characteristic of the synthetic detergent. The ABS then gives many packaged products their cleaning power -- and also contributes to their foaming characteristics.

With increasing use of these packaged detergents, reports began to appear of excessive foaming in rivers, streams and sewage treatment plants. While it is known that many incidents of foaming had occurred long before synthetic detergents existed, there did appear to be a cause and effect relationship. As early as 1951 the Technical Advisory Council of our

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Association began investigating the problem. The preponderance of evidence pointed to the ABS molecule as the primary cause of the problem. ABS by its chemical structure is difficult for the organisms present in modern secondary sewage treatment plants to break down. In an activated sludge plant where we might expect a 90 percent reduction in BOD, a reduction of 60 percent in the ABS present is common. In trickling filter plants, a somewhat lower efficiency is often realized. But just how significant is this reduced efficiency or lower biodegradability? Let's for a few moments consider the concentrations with which we are dealing. In the dishpan the concentration of ABS is in the general order of 400-600 ppm. By the time it goes down the drain and is diluted by other water in the sewer, an ultimate concentration of some 10 ppm finally reaches the sewage treatment plant. This level becomes insignificant when compared to the total organic pollutantal concentration of the waste at that point, measured by the BOD, which is perhaps in the order of 250 ppm. Since we can expect a further ABS reduction of 60 percent through the treatment process, the ultimate ABS in the discharged effluent may be in the order of 4 ppm. Seemingly, this is extremely low when compared to other pollutional constituent still remaining in the treated effluent. In fact, the USPHS has estimated that in such waters ABS constitutes less than 10 percent of the total organic residue. The problem, however, exists in the fact that ABS may foam at levels as low as 1 ppm! And foam, unfortunately, is a characteristic that does not require extensive analytical facilities to observe. This, in essence, is the heart of the detergent pollution problem.

Many other charges have been directed towards detergents which when examined under the cold light of scientific investigation simply do not stand up. I believe that it is germaine to today's discussion to consider some of these charges and their true facts in some depth.

The statement has been made, mostly in the public press, that ABS is toxic to human, animal and fish life! Taken as a flat statement, a modicum of truth probably exists here -- but so are common table salt, chlorine, monosodium glutomate, and many other chemicals we use daily in our food and water if the concentrations are high enough. The USPHS in its 1962 Drinking Water Standards established a limit of 0.5 ppm ABS in drinking water almost entirely on an aesthetic basis. At this concentration, based on long-term (2-year) rat feeding studies, the Public Health Service Standards state that there exists a calculated safety factor in the order of 15,000. These standards further state that waters containing ABS are likely to be at least 10 percent of sewage origin for each ppm ABS present. Waters containing a fairly high quantity of ABS would not be safe for drinking, not because of the ABS, but because of the other pollutional materials present.

While I think it becomes clear that no practical toxicity hazard exists insofar as humans are concerned, the picture is not so clear when fish toxicity is considered.

It must be remembered that a sewage treatment plant effluent containing 4 ppm ABS is immediately further diluted as soon as it reaches the receiving stream. In fact, studies conducted by Dr. Charles Renn of The Johns Hopkins University and reported upon by Dr. Ruth Patrick of the Academy of Natural Sciences of Philadelphia have shown that ABS concentrations in natural waters of Maryland ranged between 0.02 and 0.1 ppm.

Dr. Patrick has further stated before a Congressional Committee that ABS could be toxic to some species of fish at concentrations of 4 ppm or more. It can be concluded then that some fish toxicity could occur in sewage treatment plant outfalls -- areas where fish could not survive because of low dissolved oxygen levels and the presence of other contaminants -- not because of the ABS present.

Certainly there is evidence that the ABS concentrations in American streams are well below the fish toxicity level and have remained at these low levels for several years. In other words, there has been no gradual build-up of ABS concentrations.

Another commonly heard charge is that ABS causes tastes and odors in water. In a study conducted by the Robert A. Taft Sanitary Engineering Center and reported upon in the May 1963 issue of the JOURNAL OF THE AMERICAN WATER WORKS ASSOCIATION, the following was stated:

> "For the tests reported in this paper, solutions of purified ABS in distilled water were used. Solutions with ABS concentrations up to 1000 ppm had virtually no odor; however, much lower concentrations were detected by taste. Purified ABS at a concentration of 60 ppm in water was detected in taste tests by 50 percent of a panel of judges; the lowest detectable concentration, 16 ppm was detected by only 5 percent of the panel. The ABS concentration in finished water rarely exceeds a few tenths of a ppm.
>
> "Data from this study clearly indicate that ABS alone at the concentrations usually found in finished water cannot be the cause of either taste or odor. ABS is always accompanied by other contaminants from domestic or industrial sources, however, and the reported taste and odor must be attributed to these contaminants."

Applying the USPHS 10-to-1 rule, at the lowest detectable level of taste caused by ABS, 160 ppm of other sewage or industrial waste organic residue would be present in the water -- not a very appetizing thought.

Clearly then the allegation that ABS causes tastes and odors in water is simply not true -- certainly not at the levels with which we are dealing.

A question often raised and one which deserves careful consideration is the inter-relationship of ABS, septic tanks and ground water pollution.

The problem that has developed in this regard has received national attention in such places as Long Island's Suffolk County, parts of Connecticut and Maryland and in other areas. As we see it, this is a serious problem and one that will become more serious in the years to come.

Unfortunately, in this matter the issue is somewhat beclouded. Generally speaking, the mechanisms of biological degradation in septic tanks, cesspools and subsurface soil disposal systems are not well understood. Many theories have been proposed to describe the breakdown of organic matter through these processes, but none has really delineated the physical and biological phenomena involved.

I think that it is agreed, however, that these methods of waste disposal, particularly when the water supply is drawn from nearby wells, offer marginal safety at best and can be absolutely dangerous under less than idealized conditions. Accordingly, our Association has both sponsored and cooperated in research work designed to further our knowledge of this very critical area. The magnitude of the problem is perhaps best illustrated by an evaluation of the data presented in the UNITED STATES CENSUS OF HOUSING, 1960, which indicated that 19,674,248 (33.8 percent) of our national housing units did not have public sewerage service.

As a result of this research effort and others, certain facts have been developed. ABS, and for that matter most organic pollutants, is difficult to remove under conditions in which the waste is discharged to water-saturated soils. By the same token, very little degradation is achieved when wastes are discharged to essentially sterile soils devoid of reasonably heavy growths of bacterial life. We have also learned that the presence of ABS in systems of this nature does not enhance the passage of coliform organisms through soil nor is there any inhibitation of bacterial degradation in the presence of ABS. Thus, some of the fear associated with the passage of detergents through septic tanks and cesspools and subsequent sub-surface disposal appears unfounded. Nonetheless, some very serious problems persist.

I think that we have all read of incidents that when water is taken from the tap in certain areas of Long Island, a head of foam appears. Unfortunately, the public press seems to have drawn the wrong conclusions from these incidents. The presence of foam in water is not the manifestation of a particular evil associated with detergents or more specifically, ABS, but is, in fact, the indicator of a far more serious overall pollutional problem. Septic tanks and cesspools are notoriously poor waste treaters and cannot be expected to handle the type and quantity of loadings imposed in limited areas available in our modern suburban developments.

Nonetheless, these installations exist and must be accepted as part of our modern environment. Recent work conducted by Professor McGauhey at the University of California and others indicates that septic tanks and tile drain fields can be designed to provide reasonably good removal of ABS and other organic pollutants. Obviously, the degree of treatment achieved cannot be as good as that expected through municipal or regional plants but can be considerably better than that which we have seen in the past. We do feel, however, that every effort must be made to develop plans and programs for the ultimate construction of adequate central treatment facilities for our burgeoning suburban communities. Short of this, assurance cannot be given for the long-term protection of the water supply sources and recreational facilities of these areas from over-all sewage pollution.

These facts which I have been discussing are admittedly defensive -- refutations of fallacies and delineation of facts as they relate to detergents and our national water resources.

There is a positive aspect to this problem as well -- one of which our industry is quite proud and which is, in fact, part of the continuing industrial revolution.

In April of this year, Mr. E. Scott Pattison, manager of our Association and speaking for the 90 percent of the industry that we represent, announced that by the end of 1965 our industry will have converted to a new, more highly degradable surfactant. This material, to be generally known as Linear Akylate Sulfonate or LAS, will replace ABS as the principal surfactant portion of the packaged detergent.

While it is certainly dramatic in itself that a major industrial product changeover is in the process of taking place, an even more impressive fact presents itself to those concerned with water pollution control. To the best of our knowledge, this is the first time that a product changeover of this magnitude has been made solely to resolve a water pollution problem. This is particularly startling since it is generally agreed that the contribution of ABS to water pollution is small and almost entirely aesthetic in nature.

Our industry, however, because of its very close relationship with the vast majority of the American public through its products is most sensitive to the wellbeing of its customers. We perhaps were the first to accept ABS as a pollutant -- and it is a pollutant -- and to initiate a multimillion dollar, industry-wide research and development program aimed towards new materials which would minimize the problem.

While this action will undoubtedly have far-reaching effects, it cannot, unfortunately, be offered as a panacea for all water pollution problems. The role detergents play in pollution is small in comparison to the measurable and as yet undefined pollutants present in our waters. Even if detergents were completely eliminated, this action could not hope to solve the complex water pollution problems with which we are faced.

However, if maximum advantage is to be taken of this technical breakthrough in developing and marketing more biodegradable detergents, it must be coupled with effective and complete waste treatment facilities.

Improved biodegradability implies the capability to degrade biologically and so, the interrelationship between waste treatment and the removal of a particular waste constituent becomes even closer than before. Our industry then is committed towards the encouragement of replacing inadequate and archaic waste treatment systems with complete, secondary treatment facilities or, when this is not feasible, at least providing well designed and operated individual treatment devices.

Assuming that these facilities are available, we will see a diminution of foam in our streams and sewage treatment plants and hopefully, the end of sudsy drinking water. We know that to achieve this will take time, money and patience, but we do feel that cooperation between industry and water pollution control agencies can only result in the improvement of our vital national water resources. We are proud to share and to contribute to this effort and to play our part in the continuing revolution.

STATE - FEDERAL RELATIONS IN WATER POLLUTION CONTROL

by

Loring F. Oeming*

Up until six years ago, the States had exclusive jurisdiction in the field of water quality management. This is no longer the case. The Federal government now has authority to enter the scene and initiate enforcement proceedings under the Federal Water Pollution Control Act of 1956 as amended in 1961.

A serious impediment to the attainment of improved water quality management objectives throughout the Nation, seems to be arising in the present conflict of views as to the respective roles of the State and Federal governments in enforcement. Unless an apparently growing breach in this field of activity is healed, the consequences may well reach disastrous proportions. In recognition of this situation, the State and Interstate Water Pollution Control Administrators devoted most of their December 6, 1962 meeting in Chicago, to airing the causes of friction and seeking a basis for improved relations.

The problem appears to date from the December 1960 Conference in Washington, D. C., called by Secretary Flemming of Health, Education, and Welfare at the direction of President Eisenhower. Statements by members of Congress at that time promised bills and legislation to further strengthen Federal Water Pollution Control powers. As if in answer, a standing vote of those present made it clear that no further extension of the then existing powers of the Federal government was desired or necessary.

The 1961 enactments are familiar to all--Public Law 87-88 provided for more Federal participation in the total problem.

The Interstate Conference on Water Problems meeting December 5, 1962, in Chicago, adopted a resolution seeking to set forth the conditions under which Federal enforcement powers should be invoked. This was promptly picked up the following day by Assistant Secretary James M. Quigley in his luncheon address before the State and Interstate Administrators. Before he had finished, he made clear his opinion that this was no way to improve State-Federal relations and all administrators should remember that a Federal Act is on the books which requires observance and enforcement under the procedures adopted by Congress. The closing remarks by Curtiss M. Everts, Chief Sanitary Engineer, Oregon State Board of Health, also incorporated in the December 6, 1962 minutes, attempted to mediate the dispute between the parties and set forth the obligations of the States as well as the Federal government to make effective this partnership effort which is in existence. The appropriateness of his efforts is brought into sharp focus in the most recent appraisal of State-Federal differences made by the Public Administrators Service of Chicago (April 10, 1963 transmittal to G. E. McCallum). Incorporated in a Memorandum Report of a Reconnaissance Study of Water Pollution Control Administration, are several pertinent pages, but two quotations invite particular reflection. While pointing out the change of emphasis in water pollution control from the wholly sanitary to sanitation plus conservation, and identifying the sensitive area in State-Federal relations as being in enforcement, it goes on to say:

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> "The existing arrangement has aspects that are obviously welcome to State authorities. The system of grants to State administration contributes to State funds and makes minimum demands in return. Federal construction grants for sewage treatment plants are administered by the States and offer the State agencies useful additional leverage in dealing with local governments. The very effective research facilities of the Public Health Service are available to State authorities which would otherwise have to set up their own establishments. PHS regional offices are available to render assistance, and seem in most cases to be on cordial terms with state agencies."

And further:

> "There appear to be other possible causes of friction between Federal and State authorities, including less than adequate liaison between the various Federal agencies directly and indirectly interested in pollution control."

Recent hearings (June 17-20, 1963) on S. 649 provided by the Senate Public Works Committee and of the Jones Subcommittee of the House of Representatives during the same week, make it clear that State and Interstate control of pollution as we used to have it, is gone--never to return. State controls will be subject to Federal examination and the State Administrators had better be prepared to relinquish some of their independent judgments and policies in favor of a closer partnership with Federal authorities, even though they may not like it.

Public pressures and attitudes are now so widely and strongly expressed that the alternative to cooperation with Federal agencies is loss of public confidence and displacement of state authority over a period of years. This is not to say that we should accept those proposals in S. 649 and related bills which would further erode the authority of the States to do the job which remains with them, under the present Act. The door has not been closed for action by the States as yet. They still have the opportunity to demonstrate their ability and willingness to perform.

If there is to be an effective Federal-State partnership in this endeavor, real effort is required by the administrators at both levels. There is too much at stake to pursue a course which will weaken rather than strengthen a firm partnership effort. The present attitude of the country on the needs for better control of pollution will not countenance for long any obstructions to this end arising from differences of viewpoints on jurisdiction. The States cannot afford to allow such differences to create an impression in the public mind that we are not responsive to the needs or that we see no urgency about seeking further improvement. Failure to reconcile our differences with the Federal authorities, and vice versa, will have an increasing tendency to be interpreted as a defense of the status quo, which in most instances where Federal attention has been directed, has been recognized by the States as unsatisfactory. Having knowledge of these deficiencies, and needs for correction, and having acted to initiate improvements, the States can easily be placed in an untenable position if they oppose Federal activities having the same ends in view and directed in a constructive manner. Conversely, the States are entitled to a full recognition by the Federal administrators of the steps that are being taken by the States, their record of achievements, and their abilities to cope with the problems.

Conferences initiated by the Secretary of HEW, under the provision of Section 8 of the Federal Act, have pinpointed practices and policies which strain unnecessarily the relations between the two parties. These points deserve attention and resolution by both parties before a truly combined effort can be said to exist. Unless they are rectified, the conference procedure is in danger of becoming more a forum for airing antagonisms and differences of opinion between the parties, rather than an exploration of facts about water pollution, an objective appraisal of needs, and a determination of how best to bring to bear the functions of the respective Local, State and Federal authorities in meeting these needs.

Eradication of the defensive attitudes on the part of the States which are engendered by some of the steps taken in initiating the Conference, will do much in increasing the effectiveness of the Conference.

Many of you have been called upon to participate in the more or less formalized Conference procedure. Many more will be involved in the months to come, judging by the flurry of Conference calls that have been issued recently.

The reaction to such a call can be that the State's integrity is affronted and that it is giving expression to a lack of confidence in the State's ability to cope with pollution.

Rather than taking this view, the States would do well to accept the call as an opportunity to inform all parties fully on their authority, program activities, measures taken, past accomplishments, and future prospects.

The States involved in the conference are not now privileged to know precisely what reports, surveys and investigations serve as the basis for the Secretary's conference call. This destroys confidence in the motives of the call, and places the States in a distinctly unfavorable position when called upon by their governmental officials and their constituents to explain what prompted the Federal action. Equally important, if a State is to make a constructive contribution to the conference, it needs to know in what respects the Secretary considers the situation to be within the scope of the Federal Act. This information should be available to the States either prior to, or at least at the time the call is issued. It would make the Secretary's action more meaningful and would create a better atmosphere at the conference if the results of investigations, now being made by the Technical Services Branch of PHS after the call is issued, were before him at the time he calls the conference.

The sequence of steps in a recent conference, initiated by the Secretary, on the interstate waters of the Menominee River between Wisconsin and Michigan, illustrate this point.

(a) Notice to the States by letter dated August 7, 1963, from Secretary Celebrezze, that the conference would be held November 6, 1963.

(b) September through October, 1963--exchange of letters between the State and the Secretary in which the State sought to be informed of the reports, investigations or surveys upon which the call was predicated, concluded with an expression by Assistant Secretary Quigley that "reports from members of Congress, conservationists or concerned citizens," constitutes evidence persuasive enough to warrant a conference. Copies of these reports not given to the State.

(c) Survey of the Menominee River and tributaries by the Technical Services Branch of PHS between the dates of July 30 and August 16, 1963.

(d) Presentation to the States of the PHS survey report on September 30, 1963.

Clearly, this succession of events imposes an unnecessary hardship on the concerned States in preparing themselves to place facts before the conferees that will be relevant to the problems defined by the Federal authorities, and that will assist the conferees in reaching a logical conclusion.

Our concern with this order of procedure is that it does not encourage an objective approach to the conduct of the Federal survey and the drawing of conclusions from the data obtained. Additionally, it leaves insufficient time for the States to digest the report and develop its views on the issues for presentation to the conferees. Cooperation and assistance of the State agencies can be better obtained with less disruption of the State's over-all pollution control effort, and without diminishing the value of the conference, by a revision in this order of procedure.

Greater opportunity must be provided for an exchange of viewpoints and information between the States and the Secretary than is offered by the formalized conference process. The enforcement provisions of Section 8 are not the only course which the Secretary is authorized to pursue in improving control of pollution of interstate waters. Section 2 of the Act, providing for comprehensive programs, offers an alternative that merits more attention than it has received to date. This procedure has as much potential for reaching the over-all objectives of the Act as has the enforcement procedure. The current Federal program stresses enforcement as the way to get results, and gives very little weight to what has been, and will continue to be accomplished on a cooperative compliance basis. Recognition of the amount of pollution that has been, and can continue to be, abated through voluntary action by the offender, will broaden perspectives on the course which State and Federal action should pursue. This perspective is lacking in the currently indicated Federal preoccupation with viewing the numbers of Orders issued and the Court enforcement actions taken, as a measure of the effectiveness of control programs.

Despite the potential value in using Section 2 for the solution of interstate problems, no inclination has been evidenced of a desire to use the comprehensive program approach. The question that needs answering is--"Why hasn't it?"

Comprehensive planning implies that the full range of present and future prospective water needs receive concurrent attention in charting our future courses of water use and development. Action, to date, is centered on the effects of waste disposal use, without taking into account that this is one of many uses that the resource may be called upon to serve.

The Federal and State agencies have yet to come to a meeting of the minds on what constitutes "pollution," whether either the comprehensive program or enforcement approach is taken. The degree of pollution is a crucial consideration in the over-all management of the resource. Pollution, unlike pregnancy, can be experienced in varying degrees. Currently, the Federal agencies seemingly subscribe to the pregnancy concept.

In conclusion, I would like to draw on the comments in an editorial on the Menominee River Conference by one of Michigan's newspapers.

> "People will have no quarrel over the desirability of pure waters. They are more precious to the local citizens than they are to persons in Washington. But they are concerned practically and seriously with the survival of local economy. Without that, it won't matter much about the quality of water in a river to people living in its watershed. Promises of higher standards of water quality than now prevail will be empty unless much greater thought is given to multiple uses of water."

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PESTICIDES OR HUNGER

by

Robert White-Stevens*

During this decade of the twentieth century, it is particularly fitting that we look back over the road we have come in the past 100 years and assess that which we should follow into the future. For the 1960's mark the centennial of the land-grant college and experiment station in America, a system which has contributed much to American progress, both at home and internationally. It has produced a food explosion that more than matches that of the population in North America.

This century is the most crucial for all mankind. It has been a turning point in man's long struggle against hunger and want. In ancient days, and even in some parts of the world today, farming was guided by superstition, prejudice and ignorance. The farmer's labors were long and arduous, so that he had margin of neither time nor effort to study and assess the laws and ways of Nature revealed in the husbandry of his crops and animals. He had neither time nor equipment to search for and develop such knowledge. Insect depredation, disease, and weather devastation were interpreted as punishment from the gods for sin.

In this century, these shackles have been cleft and cast aside, at least by the Western nations, and man has learned how to banish hunger and want from the earth. Agricultural science has found the way to produce all the food and fiber needed for all the people on earth now and for the many more yet to come, far into the future.

That over 65% of the world's population still die either directly or indirectly of malnutrition is no reflection upon science but upon the social, religious, economic and political restrictions and morés which still bind man to the mill of his own ignorance and misery. The burgeoning billions of this earth, increasing now at an incredible 7000 per hour, may soon so overwhelm our technical organization and scientific detachment, so essential to tranquil, objective, experimental inquiry, that we may have to "devour our seed" before it can be made to multiply.

As DeGraff has announced in his law of food and the progress of people, "The culture of a people is inversely proportional to the time and effort required for their subsistence". In former times the culture and power of a people rested upon conquest, subjugation and slavery; today it can rest on science to the dignity and benefit of all mankind.

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This is the great achievement of our century; it supersedes in its basic significance to man even the dramatic developments in electricity, medicine, engineering, nucleonics and space flight. For scientific agriculture, integrating the work of many people and disciplines within a framework of free thought and enterprise, has brought abundant, nutritious and safe food to hundreds of millions for an average current cost of but 20¢ of the take-home dollar. In the U. S. this has allowed 90% of our people to spend 80% of their work effort on production other than food. These people, released from farm labor staff our schools, colleges and research laboratories, build our cities, bridges and highways, toil in our mines and industries, post our civil services, succor our indigent and sick, create our cultural arts, and man the ramparts of our defense. They have in short, made our nation great, and the undisputed champion of free men everywhere.

The attack on hunger was deployed into four basic and equally important areas:

> First, as education and extension of the findings of research and development at grass roots level on the farm;
>
> Second, biology (genetics, physiology and pathology) to improve, utilize and protect our animal and plant stocks;
>
> Third, engineering, to provide production power to facilitate transport, to process and to protect the foods produced; and
>
> Fourth, chemistry, which reveals the very functions of life itself and how to control them.

These four legs support the table of splendor in America today; if any one be removed or tampered with, the table will sag and pitch our food surfeit into scarcity and want. For our food surplus, over which much political hay is made, is nonetheless a bounty bequeathed us from the researches of our scientists and the labors of our farmers over the past hundred years. It is our margin of safety in a hungry and envious world; it represents one insuperable barrier to Communism in the Western world; and it costs the American taxpayer but a fraction of what he would pay in increased food prices were a corresponding deficit to occur.

Curiously, the very competence which advanced the American farmer from feeding himself plus three others in 1860 to feeding himself plus twenty-five in 1960 have assigned him to political minority. In a democracy this can be social and economic suicide unless the majority who have the controlling vote have a full and abiding understanding of the minority's rights, purposes and function.

This apparently is not the case. A whole new generation has grown up without the slightest interest in agriculture. To them, food comes in discrete packages at the local supermarket; it is cheap, and, they say, of course, it should be; it is abundant, it has always been so and therefore, they note, will it not always be so? It is clean, uniform, attractive and nutritious, as obviously, they contend, it must be by law. "So," they ask, "what's all this fuss about disease, insects, pesticides and food additives? We don't want bugs in our food and if pesticides and food additives are dangerous, then we don't want them either. So, let's have a Congressman or two pass a law or two to ban all pests and pesticides."

"After all," they insist, "it's up to the farmer to produce clean, pure food, free of bugs and chemicals. We pay him enough, don't we? Look at the whopping farm bill every year and all those subsidies and the millions of tax dollars spent for farm research and farmer education in the land-grant agricultural colleges and experiment stations. It's all for the farmer, isn't it?"

This reveals a large vacuum of information among our urban peoples, which we in industry and in our land-grant college extension system have perhaps been remiss in filling. We need to convince the urbanite that he is the larger beneficiary of our farm support research and education; that he is the ultimate consumer of the cheap abundance and choice variety of foodstuffs; that he currently feeds his family for about half of what it costs his contemporary counterpart in the most progressive of the other Western countries; that the total cost of agricultural research -- federal, state and industrial -- over the past hundred years ($13 billion) is more than offset in a single year by reduced food prices.

Adding to the confusion of our urban people, there has recently splashed into print numerous articles, treatises and books which appear designed to promote circulation rather than veracity. Some are plainly fanatic, spurious and self-contradictory. Ringing their own knell, they quickly recede before the ridicule of the reading public. Others, skillfully written and supported in part by carefully selected and often misrepresented scientific documentation, have enjoyed a more prolonged interest.

Agricultural chemicals in particular have been singled out for attack, as have the chemical industry that researches and manufactures them, and the land-grant colleges, the experiment stations and the federal programs responsible for the development, application and proof of safety of each compound. These federal and state groups have been accused of aiding and abetting industry in unloading untested, untried and unsafe compounds upon an unsuspecting public. This scurrilous accusation must be viewed in the light of the facts that the total pesticide industry represents a dollar volume a trifle over 1% of the total chemical industry's annual product, and that the total financial support of the chemical industry to the land-grant college system is less than 4% of the colleges' budgets. Even the most venal critic must appreciate that neither of these items could be a major factor in fiscal or moral deviation by university or industrial scientists.

Nevertheless, the chemical industry stands indicted as a polluter and contaminator of the environment, as a poisoner of foodstuffs, as a destroyer of wildlife, and as a befouler of land and water.

Preposterous as these indictments are to us of the industry, the condemnation is considered correct and just by many people. Today when the public image an industry carries is highly significant to it, we have been pictured as modern alchemists, whose black magic contributes to pollution, poison, corruption and death. Groundless as these implications are, a large segment of the propagandized public has come to regard agricultural chemistry as an enemy of mankind.

This is serious for the chemical industry today, as it is for many related and ancillary disciplines. Utterly untrue as the accusations may be, nonetheless we have before us a substantial educational program which obviously we have too long neglected.

The record of agricultural chemicals research, development, manufacture and application is essentially unblemished. The few minor errors, accidents and misapplications are insignificant when related to total usage and performance.

Admittedly and unfortunately, industrial accidents with pesticide chemicals occur among manufacturers, formulators and applicators, a few each year being fatal; in an average year, however, they are fewer than the home fatalities from familiar household chemicals or even from insect stings and bites. This is an incredible safety record when one considers the wide use of such compounds. Further, there is not one medically annotated case of any U. S. government registered pesticide causing sickness, let alone death, to any consumer of any foodstuff when such pesticide has been used as recommended on the label.

Obviously, misuse of registered compounds or any use of unregistered compounds in or on foodstuffs directed to human consumption is reprehensible, and properly punishable by law. It has undoubtedly occurred and perhaps will again, but such abuse cannot justly indict the rest of the industry that scrupulously obeys the law and takes every measure to protect the public.

A death or illness from the misuse of a pesticide, regrettable as it may be, is no more the fault of the compound or its manufacturer than a death in an automobile collision is the responsibility of the car manufacturer.

The most recent publication sowing distrust in and misgiving toward the chemical industry and our land-grant agricultural experiment stations is Rachel Carson's book Silent Spring. Miss Carson writes of biological subjects with an extraordinary touch and elegent expression, but in spite of her convincing indignation and prodigious following, her furious theme will fade as her readers turn back to practical realities of man's struggle with insects, weeds and disease.

The anti-pesticide philosophy is straightforward and plain. It contends that a balance of Nature is essential for the continued existence of all life forms including man, and that man has deliberately disturbed this balance by introducing new and unnatural chemicals into the environment in ungoverned volumes for temporary expediency and immediate profit. It is claimed that irrevocable damage has been committed in many areas. References, in many cases irrelevant, have been carefully selected to support this contention. On the whole, these claims distort the facts, and are unsupported by scientific evidence or practical experience. Emphasis is deliberately misplaced and there is omitted a great mass of favorable evidence, documented by literally tens of thousands of published scientific papers.

All the safety measures which research has laboriously developed and built into each new agricultural chemical marketed are either discounted or deprecated. Concomittantly, the alleged hazards are inflated to staggering dimensions. The practical facts, that danger must be a part of all progress and that new machines, new drugs, new chemicals and indeed new ways of life entail hazards, are ignored. These critics fret over every possibility of harm rather than assess the realistic probabilities of error.

Conveniently omitted is the well documented evidence that without chemicals to control crop pests, fully one-third of our people could not be fed; that insects destroy, even with use of pesticides, several times as much lumber each year as all the forest fires; that over the past twenty years organic insecticides have saved more human lives than all the wonder drugs combined by reducing the insect vectors of such scourges as malaria, typhus, bubonic plague, encephalitis, elephantiasia, yellow fever, dengue, yaws, trachoma, trypanosomiasis, Chaga's disease, dysentery and cholera.

Miss Carson and her followers deliberately ignore what she, as a biologist, must know to be fact, that since time began the so-called balance of Nature in no way favored man; that he commenced to disturb it the day he swung down from the trees, picked up a stick, and went after other forms of life. It is man's burgeoning numbers rather than his way of life that has tilted the balance in his favor, for man himself has grossly exceeded the population level that Nature would tolerate in the wild. Modern man recognizes that Nature is "red of tooth and claw" and he intends to hold on to every advantage he may need, including pesticides, to sustain his dominion.

The real danger to man's survival lies not in the controlled use of chemicals but in the hoards of insects and miasmas of disease which would sweep over our crops and animals, denude our forests and leave hunger and destitution in their wake.

If the Carson proposals were carried out, life would return to the Dark Ages; insects, disease and vermin would once again inherit the earth.

It is stated that our lands and waters have been universally and irrevocably contaminated by a veritable rain of pesticidal poisons. Yet comprehensive surveys by our USDA, various state boards of agriculture and the Entomological Society of America show that somewhat less than 5% of our total land area is sprayed with insecticides in an average year; that less than 3/10% of our forest and wild lands, where the bulk of our wildlife dwells, are so treated; that only 3% of our marsh and swamp lands, where insect vectors of human disease breed, are sprayed. This is hardly universal contamination.

The contention is made that modern pesticides are so toxic as to destroy all life exposed to them. This absurd statement ignores the obvious fact that without selective biological activity these compounds would be utterly useless.

Chemical control of insect pests is attacked on the ground that the insects rapidly develop resistance to the pesticides while vertebrate wildlife does not, and that man must continually escalate the toxicity of new and the dosage of old compounds to keep pace. This, it is claimed, is a futile endeavor which merely selects and generates super-insects and increasingly endangers vertebrate wildlife.

The facts are that although some insects do indeed develop resistance such resistance is quite specific to but a single compound and, in some instances, to its close analogues; that cross-resistance over an array of chemically unrelated compounds does not occur; that resistance to a particular chemical is not the result of induced mutation but of the selection of an intrinsically present genic composition; that such resistance in no way indicates general biological superiority, and, in fact often reveals biological inferiority; and, finally, that chemical resistance to chlorinated hydrocarbons actually evolves among wild vertebrates (fish, rodents, frogs) in about as many meiotic (reproductive) cycles as it does in insects.

Particularly denounced is the mass spraying of forests and wild lands to eradicate such pests as the gypsy moth, the Mediterranean fruit fly, the fire ant, grasshoppers, spruce bud worms, etc. It is contended that the treatment elicits more damage than good. Actual wildlife counts in sprayed and ecologically comparable unsprayed areas are admittedly limited, but where they have beet made the data generally reveal that the mass spraying either had no significant effect (California) or actually improved the natural conditions for wildlife, (Pennsylvania).

It is claimed that new untested agricultural chemicals are poured out in a relentless stream every year upon an unsuspecting public. The fact is that only some 200 new pesticides have been introduced over the past twenty years; many of these are close analogues of predecessors and therefore much of the necessary biological evidence overlaps. In any case, each compound is now exhaustively researched and tested from 3-5 years at a cost of over $2.25 million, to assess its efficacy, toxicity, metabolism, stability, and its economic validity. No company would be so cavalier as to approach the market with an ineffective, unsafe or economically invalid product, even assuming that it could effectively dodge the collective inspections and crucial study of the USDA, the FDA and various state boards and departments.

Miss Carson contends that because most of the newer pesticides "are the synthetic creations of man's inventive mind, brewed in his laboratories and having no counterparts in Nature", they are therefore poisonous and life as a whole cannot cope with them in anything less than "generations".

New molecular configurations occur continually in Nature, far exceeding man's synthesis of new chemical forms. Most of these may well be but minor modifications of parent molecules; others may differ radically. This is biochemical evolution. If a new molecule within a living creature is toxic to it, it becomes a genetic recession and may even be a lethal gene, destroying itself; if non-toxic to its host, but toxic to competitive creatures, it may become a new force for survival of the race.

In the same way, new molecular products of the synthetic chemist can be toxic or innocuous or beneficial, depending upon the host, the use and the dosage.

Miss Carson and other writers have confused notions of what is a poison. She seems to think of chemicals and poisons as being synonymous, when actually all poisons are chemicals -- whether one becomes a poison depends upon its use . All compounds can be poisonous or non-poisonous depending upon the form, the host, the route of exposure, the dosage and the metabolism of the host. To deny this concept is to cancel out the whole basis of therapeutic medicine. Yet this is precisely what is done when it is implied that if a compound is toxic at 500 ppm, it is also toxic at 1 ppm, and that if a substance is carcinogenic at 1000 ppm, it must be regarded as carcinogenic at 0.1 ppm. From this incredibly misleading conception arises the furious argument for a "zero" tolerance of pesticides on food. Surely it should be clear to all that "zero" is an impossible value to assay, and from elementary chemistry it is obvious that if a compound comes in contact with a plant or animal, the probability of eliminating every last molecule of residue is virtually incalculable. For example, one pound of DDT distributed evenly over the continental limits of the United States would leave a residue of over one billion molecules per square foot.

In the title of her book, and echoing through virtually every chapter, is Miss Carson's love of birds and a deep concern for their fate, which she contends is seriously threatened by the increasingly widespread use of toxic chemicals. Certainly most of us share her love of birds. All of us would be sincerely disturbed if indeed whole races of native birds were being destroyed by pesticides. She says in her chapter "And No Birds Sing": "... over increasingly large areas of the United States, spring now comes unheralded by the return of the birds, and the early mornings are strangely silent where once they were filled with the beauty of bird song."

Phillip Marvin of Manhattan, Kansas, an interesting combination of entomologist and ornithologist, recently drew my attention to the Audubon Society Christmas Bird Count, an annual event among society members all over the nation since 1899. The program follows rigorous rules as to when, how, and where the counts are to be made in various geographic locales throughout the country. The collated records are published both as regional reports for each party and also, in recent years, as consolidated tabular summaries by bird species. This annual census is the most comprehensive report of the bird status in America, and Miss Carson herself refers to the bird watching members of the Society as having an "unparalleled knowledge of bird life in America".

What does a critical examination of these bird data over the past twenty years reveal, particularly in the light of the introduction of synthetic pesticides in the early forties?

First, by the most conservative estimate, the overall count reveals a bird population increase of at least 700%, which more than matches that of the human population.

Second, with the exception of ducks, doves, partridges and pheasants, birds that are vigorously hunted and frequently over-bagged, all other birds are either holding their own or increasing at a prodigious rate. Robins, over which Miss Carson despairingly cries requiem as they approach extinction (see page 118), show an increase of nearly 1200% over the past two decades. Similarly, substantial increases have been racked up by cardinals, thrushes, vireos, wrens, mourning doves, mockingbirds, and woodpeckers; the grackle and the redwinged blackbird are now vying for number one position over the sparrow and starling. In southern New Jersey, in the major fruit and vegetable growing areas, the bird depredations have become so serious, causing crop losses of over $200,000 per annum in one county alone, that the local agricultural board has sponsored a September-October bird hunt contest.

So substantially have many bird species increased their numbers that one is tempted to make out a case for pesticides as being the major cause of bird survival through the reduction of insect vectored avian disease.

So, on the basis of the Audobon Bird Counts, one is led inexorably to the thought that if Spring ever does come to us silently, it will be because the birds have shrieked themselves hoarse trying to be heard above the crowd or are just too exhausted with family affairs to sing.

It is maintained that the chemical approach to pest control is "born of the Neanderthal Age of biology", and that "the concepts and practices of applied entomology for the most part date from that Stone Age of science". It is contended that a more sophisticated "balance of Nature" approach in the form of biological controls, using predators, insect pathogens, male sterile techniques, resistant varieties of crop plants, and an integration of any or all of these should be practiced, with minimal dosages of only those chemicals which are nontoxic to vertebrates, of fleeting activity and of high specificity against target insects.

Actually, all of these suggestions have been investigated intensively by research entomoligists and plant pathologists. Indeed before the discovery of the organic pesticides these were the only methods of control, and a very inefficient and unreliable control it was. A few biological methods, all too few, proved successful, and were developed and effectively applied. Thus, rust resistant wheats and asparagus were developed, and a few insect resistant varieties of crop plants were found and bred into domestic lines. But these were inevitably restricted to only one or, at the most, two or three specific pests, and often at the expense of yield, quality, seasonal response, frost resistance, etc. Biological predators were effectively introduced in some cases, and a few outstanding examples are recognized: the vadalia beetle control of citrus cushony scale; the Coccinella beetle larvae control of certain aphids in isolated valleys of the Western mountains; the use of beetles to suppress the Klamath weed; Bacillus thuringiensis and polyhedrosis virus to control certain Lepidopterous larvae; and the milky disease to control Japanese beetle larvae. Again, each of these methods is quite specific, of limited scope and duration, hard to apply, expensive to prepare and maintain, and inadequate to ensure the grower a reliable control. Even the male sterile technique which was so brilliantly effective against the screw worm is absolutely specific, exceedingly expensive to develop and apply, and is of practical value only where a particular pest is the prime goal. The male sterile technique combined with the new chemical lures (synthetic chemicals, incidentally) cannot be regarded as practical for the individual farmer, although it may well aid him by holding down native species and eradicating exotic imports. The suggestion of using sub-lethal doses of chemical pesticides is exceedingly ill-advised, for this will very rapidly promote insect resistance to the applied compounds and vitiate their value.

The recommendation that modern farming abandon monoculture and return to mixed farming is to ask the nation to abandon its present standards of living, dispose of some 100 million surplus humans, and turn the clock back to when men of the Western world were indeed close-locked with Nature and barely holding their own.

Biological controls are too uncertain, too specific, too limited, too costly, too ephemeral, and too impractical for the modern farmer.

He must bring his crops to market unscarred by insects or disease, or he cannot sell them under the grade specifications established by the federal and state boards of agriculture. He must continually combat and hold at bay from ten to twenty different insects, diseases, nematodes and marauding vertebrates. He must do this at a minimum of expense or he cannot meet the customer demands for cheap food. If he has to go into his potato field on Monday to apply a culture of *Bacillus thuringiensis* to reduce army worms (to which, incidentally, he must bequeath a portion of his crop to sustain the parasite), and then again on Tuesday to distribute *Coccinella* larvae to control aphids, he still has to go out again on Wednesday to control leaf hoppers, flea bettles or Colorado beetle with chemical spray at full strength, for there is no effective predator for them. Obviously, it is more practical for him to spray with a broad spectrum compound and clean them all up with one pass-through on Monday.

The great bulk of crop pests can only be controlled by chemical means at this time, and merely controlling one, or indeed all but one, is essentially as futile as controlling none. A car doesn't run any better with one flat tire than it does with two or even four.

So, the probability that biological methods will play more than a secondary role in the control of crop pests is quite remote. As Miss Carson points out, relatively little research funds are currently applied to biological control, although the proportion has increased in recent years in the federal and land-grant system. But this is not, as she asserts, due to the avarice and short-sightedness of the chemical industry; it is so because experience has revealed that, with a few exceptions, most biological control is unsatisfactory.

The chemical industry does have a major responsibility to inform and to educate the consumer as to what agricultural chemicals contribute to his welfare. The dangers of these chemicals to man are insignificant when they are used properly and when related to the vast contributions they have made to man's welfare. Damage by pesticides to wildlife has been crassly exaggerated. At worst, it can only be considered a minute fraction of losses to natural forces, such as flood, drought, disease and predation. Many other areas of man's activity press upon wildlife and are considerably more harmful than the worst of agricultural chemical practice -- notably highways, airports, cities, factories, mines, power lines and TV towers, plus the overwhelming human encroachment upon the wildlife environment.

Research, development and application of new chemicals are well organized and disciplined, reducing hazards to a confident minimum. The consumer's safety is well guarded. Unfortunately, the general public is not aware of this and now false prophets deliberately mislead them.

There are those who maintain we should ignore these assaults upon our industry and scientific integrity, that time will obscure these false prophets. But for too long have we forborn whilst our critics accuse us, with impunity, of endangering the lives and health of the consumers of the foods we produce; whilst they claim, with impunity, that we have deliberately destroyed wildlife; whilst they state, with impunity, that we have universally and permanently contaminated our land's waters; whilst they clamor, with impunity, that we have with indifference and arrogance despoiled and unbalanced Nature; whilst they contend, with impunity, that we have irrevocably fouled our environment and cast a grievous shadow over generations yet to come. The time for forbearance is past. Meek acquiescence or silence before these scurrilous accusations is tantamount to pleading guilty to crimes we have not committed. We must tell the people the facts, honestly, vividly, convincingly; for if we allow superstition and suspicion to supersede scientific objectivity and research, then the dedicated effort of the past century will indeed have been futile and vain. And if we fail to heed the lesson that science and history have taught us, then we shall be condemned to live it over again!

WATER QUALITY ASPECTS OF PESTICIDES AND WASTES FROM THE MANUFACTURE OF THESE ORGANIC CHEMICALS

by

J. L. Crockett, Jr.*

The phenomenal growth of the chemical industry over the past twenty-five years, spearheaded by the continuous development of new synthetic organics, has dramatically affected our way of living. Many of the fabrics we use each day are woven from chemical fibres unknown to us only a few years ago. Plastic materials are now taken for granted and synthetic rubber is no longer a substitute material. Great strides in the treatment of disease and physical discomfort have been made through the development of new drugs. Synthetic detergents have become indispensable in industry and in our homes. Remarkable progress has been made in agricultural production through the use of pesticides synthesized from organic chemicals. Organic pesticides have likewise contributed greatly to the control of disease vectors, nuisance insects and undesirable plants.

While we have benefited immeasurably from developments in the synthetic organic chemical field, the advantages derived from this progress are, in many instances, accompanied by new and complex problems of waste disposal. Wastes from the manufacture of some of these new products contain materials detrimental to water quality. Both the production and use of others among the newer chemicals create problems of water pollution. Although problems of water pollution arising from developments by the organic chemical industry are not restricted to the production and use of pesticides, this has become of concern in some areas. From here on, my remarks will be primarily directed to the water quality aspects of the production and use of pesticides, principally those serving agricultural purposes.

The reaction to the effects on water quality through the widespread use of pesticides, whether these effects be proven or visionary, has rarely, if at all, been equaled in the history of water pollution control. This reaction has, to some degree, been stimulated by special interests although it cannot be attributed altogether to self-centered groups or emotional motivation. Concern over the effects of pesticides has been expressed by those having a genuine and objective interest in the public welfare.

It has been repeatedly demonstrated that most organic pesticides are toxic to fish and biological life exposed to very low concentrations of the materials. One of the first observed incidents of significant damage to the fishery of streams from the application of pesticides occurred in northern Alabama during 1950. Damage to fish in streams receiving runoff from cotton fields treated with chlorinated hydrocarbons was severe over a considerable area. The immediate conclusion was that heavy rains, following repeated application of pesticides, flushed the toxic materials from fields. It should be noted that this was the first year in which organic pesticides were used extensively in this part of the State. The destruction of fish was of secondary concern to state health departments and water pollution control officials in view of the fact that two of the affected streams served as sources of public water supply. This was at a time when little was known of the effects of the organic pesticides on humans or the ability of a conventional water filtration plant to counteract these materials.

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Every effort was made to determine the hazards, if any, that existed through public use of water containing the pesticides known to have been involved. Some felt that water treatment processes such as coagulation, sedimentation, and filtration would tend to reduce the hazard and others were of the opinion that no injury would be suffered since the lethal concentration for fish was extremely low in comparison to that which might be hazardous to humans. It can be truthfully said that we did not have the tools to work with in this situation. Then, as now, there were no field tests by which concentrations or even the presence of suspected pesticides could be determined. The complicated analytical procedures we know today, requiring specially equipped laboratories and highly trained analysts, were yet to be developed. Fortunately, there were no reported effects on persons within communities whose water supplies were involved.

The widespread fishery damage attributed to the application of agricultural pesticides over northern Alabama in 1950 was investigated by the Public Health Service shortly after its occurrence. 1/ One of the affected drainage areas, Flint Creek, which serves as a source of public water supply, has been the object of a continuing study by the Public Health Service since 1959. The area selected for study is, in many respects, a typical example of current practices for the control of insects economically important to the production of cotton. One exception lies in the method of application which is virtually restricted to land equipment. Chlorinated hydrocarbons, toxaphene, DDT, and BHC are used predominately. While there has been little change in acreage devoted to cotton since 1950, the quantities of applied pesticides vary from year to year depending upon insect populations and climatic conditions. Reports on the Public Health Service's Flint Creek study are interesting. Over a four-year period, 1959-1963, toxaphene and BHC have been continuously recovered from the stream and treated municipal water supply in the parts per trillion range. DDT has not been reported in the stream nor in treated water samples. Treatment provided for the public water supply (lime-alum coagulation, sedimentation, rapid sand filtration, chlorination, pH adjustment and activated carbon) is apparently unsuccessful in reducing the concentration of toxaphene and BHC. Biological investigations were conducted as a part of the over-all study in 1959 and 1960. A report[2/] on these investigations states, in part, "So far as was determined, bottom organisms and fish populations were not reduced in number or species composition. Neither was there a demonstrated effect on zooplankton, although numbers were too meager to permit critical study." So far as is known, fish kills traceable to the application of agricultural pesticides, have not occurred in the Flint Creek drainage area since 1950. Interim reports on the Public Health Service's study reflect, to some extent, what may be expected in the way of effects on stream water quality within an area subjected to continual treatment with certain pesticides of the chlorinated hydrocarbon group. In retrospect, it seems plausible to assign part of the responsibility for the 1950 incident in northern Alabama to over-treatment with a lack of recognition of the after effects.

Since 1950, five fish kills, in which the application of pesticides was suspected, have been reported for Alabama. One, occurring in 1951, was relatively extensive and considered to be a result of excessive treatment for cotton insect control. The other four kills were of minor severity and limited to small streams in the immediate area of application. Three of these, two in 1958 and one in 1960, were attributed to the use of heptachlor in fire ant control. This pesticide has since been replaced in large scale fire ant control projects by mirex, a material considerably less toxic to fish. The other kill occurred in 1963, and apparently resulted from direct application of pesticides to the water surface in an effort to control nuisance insects. While we believe that reporting of fish kills has been fairly complete, it is possible for minor situations to have escaped observation.

Knowledge gained through experience together with an appreciation of the power of agricultural pesticides and other economic poisons to inflict damage to water quality permits a more rational approach to the problem than was possible a few years ago. We know more about the possible effects of pesticides on water quality although our knowledge in this area is still far from complete. Additional information of a specific nature on permissible concentrations in water for both aquatic life and human exposure is needed. The development of procedures for determining the presence of pesticidal materials which can be performed in the field by water pollution control and water treatment plant personnel is high on the list of needs. Experience has also demonstrated the advisability of thorough investigations into the probable effects on water quality of new pesticides before they are placed on the market. The responsibility for the development of knowledge on water quality effects and techniques for determining the presence of pesticides in water rightfully belongs to the industry producing these materials. It should not be a responsibility of water pollution control agencies nor can they be expected to intelligently discharge their obligations without having full and complete information on what they are working with.

Before leaving the subject of pesticidal use, two rather severe fish kills experienced in Alabama through losses of wastes containing pentachlorophenol should be mentioned as a matter of information. Pentachlorophenol, somewhat less toxic to fish than DDT, is used by the lumber industry as a wood preservative. Pentachlorophenol is susceptible to biological stabilization although formal treatment is not usually indicated as losses of the material can be effectively controlled through good housekeeping and recovery practices. A basin should be provided, as a minimum control effort, to retain any losses that may escape recovery as a result of accidents or operational errors.

Evidently, problems created by the disposal of wastes from the manufacture of pesticides have not been widely experienced. Whether this is due to lack of reporting, provision of effective treatment, non-pollutional character of most wastes from this source, or other factors, is not known. nevertheless, a severe fish kill in Alabama resulted from the discharge of the contents of a waste treatment plant operated by a company manufacturing parathion and methyl parathion. The original purposes of waste treatment were reduction of BOD and stabilization of paranitrophenol, a by-product of the process, and not for control of parathion and methyl parathion since the company was of the opinion that these materials would not be present in the wastes. The discharge was made when a malfunction occurred in the company's treatment system which discharges to a public sanitary sewer and thence to the municipal sewage treatment plant.

The sewage treatment plant was unable to handle the increase in waste load and a large portion of the flow of sewage together with the company's process wastes and contents of its treatment facility was intentionally by-passed. This action was planned by representatives of the company and municipality although the state pollution control authority was not advised of the proposal. The probable effects on the receiving stream were considered by company officials who were concerned only with parameters such as dissolved oxygen, pH and paranitrophenol since they were apparently convinced that parathion would not be present. During the course of the discharge, purposely accomplished over a period of time, company officials routinely collected and examined samples from the receiving stream for the parameters previously mentioned. Results of the analyses revealed satisfactory conditions with respect to these specific parameters. After the fish kill was reported, samples were collected from the affected waters by investigators and analyzed for parathion by laboratories having competence in this area. Results reported by these laboratories conclusively demonstrated the presence of parathion. Without going further into the details of this situation, it can be stated that this is an example of what can happen when an industry fails to acquire all necessary information on possible effects of its waste and to inform the appropriate regulatory agency. Although knowledge came the hard way, we now know that parathion and methyl parathion are present in wastes from the processing of these compounds rather than being completely hydrolyzed as we were led to believe. It is also evident that parathion is much more stable in water than once thought. While the company deserves credit for adapting a biological method of treatment to its process wastes it was not too diligent in the original determination of the effects of its wastes on water quality.

Two other chemical plants in Alabama are major producers of DDT and one of these manufactures other compounds of the chlorinated hydrocarbon group. Wastes from the plant involved in processing a variety of pesticides have been studied sufficiently to determine that a potential to affect water quality exists. On the other hand, investigations now underway must be completed before treatment needs can be properly evaluated. It is known that wastes from the production of DDT contain the material in measurable quantities. Investigations of the plant manufacturing DDT solely are presently being conducted.

Wastes from the processing of organic chemicals into commercial products, whether they be pesticides or other materials, are so complex that it is difficult to conceive of a water pollution control agency being able to recognize and evaluate the effects of these wastes on water quality unless previous experience is available or the knowledge is provided by the industry. From all indications the chemical industry, as a whole, is sincere in its desire to cooperate in water pollution control efforts although some segments do not seem to fully comprehend the problems involved. In many cases the feeling exists that chemical reactions will be complete, that none of the product will be lost and that waste materials will only be those indicated by chemical formulations of the process. Problems of water pollution control agencies would not be so complicated if these concepts were proven by production experience. The chemical industry could make a significant contribution to water pollution control if it would apply its resources to investigation and research of the pollution aspects of the industry's wastes in a degree approaching that devoted to the development of new products.

Experience in Alabama has been used to present some of the problems created for a water pollution control agency by the use and production of pesticides. Organic pesticides have been extensively used in Alabama for agricultural purposes since they were introduced. In view of this experience and our present knowledge, it is difficult to assign major importance to the application of pesticides in assessing the over-all water quality control program in our state. This does not mean that we fail to recognize the

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possibility of acute damage through accidents, injudicious use or improper handling of materials nor does it take into account the possible effects of long term exposure to sub-acute concentrations or the build-up of more persistent compounds over a period of time. The potential for acute damage must be recognized as long as the pesticides we know today or those of similar character continue in use. The effects of long term exposure to less than toxic concentrations, build-up over long periods of time, synergism among different compounds and similar possibilities must be carefully investigated before the answer is known. Under these circumstances we should continue to encourage investigations of all aspects of pesticide pollution, maintain and expand surveillance programs and support education in proper application of pesticides.

Literature Cited

1/ Young, L. A. and H. P. Nicholson, 1951. Stream Pollution Resulting from the Use of Organic Insecticides. Progressive Fish Culturist, 13 (4):193.

2/ Thoman, John R. and H. Page Nicholson, 1963. Pesticides and Water Quality. Proceedings of Second Sanitary Engineering Conference sponsored by Vanderbilt University Department of Sanitary Engineering, Tennessee Stream Pollution Control Board and Tennessee Department of Public Health, Nashville, Tennessee, May 30-31, 1963.